JOURNAL

VOLUME 84

JANUARY
1960

Publications Committee

Chairman, C. W. HERD, B.SC., PH.D., F.R.I.C.

Secretary and Editor, F. W. GIBBS, PH.D., D.SC., F.R.I.C.

Administration

Secretary and Registrar

H. J. T. ELLINGHAM, PH.D., A.R.C.S., M.I.CHEM.E., F.I.M., F.R.I.C.

Assistant Secretaries

Administrative

D. A. ARNOLD, F.C.I.S.

Scientific

F. W. GIBBS, PH.D., D.SC., F.R.I.C.

Assistant Registrar

L. W. WINDER

Education Officer

D. G. CHISMAN, B.SC., A.R.I.C.

Finance Officer

J. F. HARDING, A.C.I.S.

Journal Subscription

30s. per annum (post free)
3s. 6d. per single copy.

Advertisements

Miss H. M. A. GARDEN,
30 Russell Square,
London, W.C.1

THE ROYAL INSTITUTE OF CHEMISTRY

Patron H.M. THE QUEEN

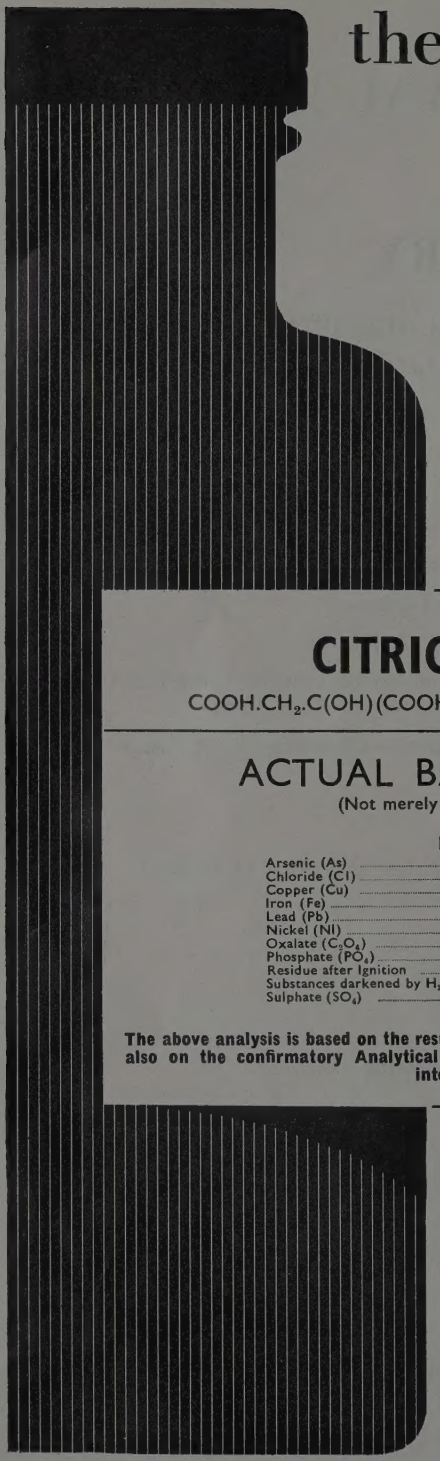
President E. LEQ. HERBERT, F.H.-W.C., M.I.CHEM.E., F.INST.PET., F.INST.F., F.R.I.C.

	PAGE
The New Journal	1
Davy, The Athenæum and the Zoo, *by F. W. Gibbs*	2
The Institute Research Diploma	4
Physics in the Service of Chemistry:	
Absorption Spectrophotometry in the Ultra-Violet and Visible Regions, *by R. A. Morton*	5
Progress in Organic Fluorine Chemistry, *by M. Stacey*	11
Book Reviews	15
Institute Affairs	23
Nominations for District Members of Council	23
Personal Notes	24
New Year Honours	24
Section Activities	27
News and Notes	38
Scientific and Engineering Manpower	40
The Register	42
Obituary	43
Local Sections—Diary and Hon. Secretaries	46

The Institute is not responsible for individual opinions expressed in articles and reviews or in reports of lectures and discussions. Editorials do not necessarily express the views of the Council.

THE ROYAL INSTITUTE OF CHEMISTRY, 30 RUSSELL SQUARE, LONDON, W.C.1

Museum 1761 - 2



the outstanding purities of **Judactan** analytical reagents

We invite you to compare the actual batch analysis shown here, with the purities guaranteed by the specifications to which you normally wor! —we are sure the comparison will be helpful to you.

CITRIC ACID A.R.

$COOH.CH_2.C(OH)(COOH).CH_2COOH.H_2O$ Mol. Wt. 210·15

ACTUAL BATCH ANALYSIS

(Not merely maximum impurity values)

[Batch No. 62118

Arsenic (As)	0·000004%
Chloride (Cl)	0·0004%
Copper (Cu)	0·00003%
Iron (Fe)	0·00007%
Lead (Pb)	0·0001%
Nickel (Ni)	No reaction
Oxalate (C_2O_4)	No reaction
Phosphate (PO_4)	0·001%
Residue after Ignition	0·003%
Substances darkened by H_2SO_4	No reaction
Sulphate (SO_4)	0·0001%

The above analysis is based on the results, not of our own Control Laboratories alone, but also on the confirmatory Analytical Certificate issued by independent Consultants of international repute

This is the analysis of a Judactan reagent. And, as with every other reagent in the series it is the *actual batch analysis*—it is one of several of which we are specially proud.

THE GENERAL CHEMICAL & PHARMACEUTICAL CO. LTD.

Chemical Manufacturers, Judex Works, Sudbury, Middlesex.

THE NEW JOURNAL

In July the Council considered the Publications Committee's plans for introducing a new *Journal* format in 1960. At that time the dispute in the printing trade was unresolved, the strike had already lasted five weeks, and the outcome—particularly as regards the magnitude of the apparently inevitable increase in printing costs—was, to say the least, uncertain. In view of this, the final decision was deferred until October. It then became clear that the additional cost of modernizing the *Journal* could be borne by the Institute.

The disadvantages of the smaller page became manifest on a number of occasions. At times the maximum size of issue for that style had been reached, and deferment of publication of some material had resulted. It was clear that with rising costs an effort should be made to secure additional revenue, and it appeared that this could best be done by adopting a new style and format.

Many of us dislike change merely for the sake of change but few will object when it can be shown to be desirable. The wrench from the old might have been more severe if the format now discarded had been with us longer than seven years and the cover design for more than five. The new format and better paper will give greater flexibility and greater freedom in the use of illustrations, and thus it is hoped to present the matter more interestingly in the future.

The Publications Committee examined several cover designs, but the present one was preferred to others of a more 'contemporary' character. The Armorial Bearings are prominently featured, the justification for this being the motto and the symbolism, some of which would be lost if reproduced on a small scale. As we are often asked to explain this symbolism, we reproduce below the original description given last year (*J.*, 102).

'The design incorporates the ancient Babylonian correlation of the terrestrial and celestial bodies, typified by the symbols of the sun and the planets, representing the metals of the alchemists; the Greek theory of the four elements—earth, water, air and fire—indicated by the two creatures acting as supporters (the hippocampus on its element water, and the salamander that can live in fire standing on earth), and the pelicans, a typical symbol of practical alchemy, here also suggesting the fourth element, air. The organic realm is further typified by the hexagon representing the benzene ring; this, with the central sun, may be considered to denote energy and stability.

'The Profession of Chemistry in its two aspects—Science and Art, Theory and Practice, Principles and Applications—is brought out in the motto: *Ratio Atque Usus*. This has been selected from several possible classical phrases sanctioned by age and familiarity: it has the merits of simplicity, balance and aptness. Taken from Julius Caesar's description of the war that brought him to our shores, it signifies the dual aspects of any science and learned profession—its corpus of organized knowledge and its practice by those skilled in its lore and precepts.'

The familiar Institute Seal with the figure of Joseph Priestley will no longer appear on the *Journal* but will continue in use on documents issued with the Institute's authority. In the absence of Armorial Bearings the Seal, designed on the lines suggested by Mr J. T. Calvert, F.R.I.C. (who has just completed 30 years of membership), has served a useful purpose in identifying the Institute's *Journal* since 1946.

JOINT ANNUAL MEETINGS WITH THE CHEMICAL SOCIETY

The Programme of Events for the Joint Annual Meetings of the Institute and the Chemical Society, to be held in Belfast on 5 to 8 April, 1960, is being sent with this issue of the *Journal* to all members resident in Great Britain and Ireland. **Those who intend to take part are asked to complete and return their application forms as soon as possible.**

Priority will be given to applications from members who have already given provisional notice of attendance by completing the form circulated last November.

If all those who complied with the request to return the provisional notice are able to fulfil their plans, more than 500 persons will take part in the principal events, and this will be very close to the maximum number for all but social functions. Any member who overlooked the earlier announcement but now wishes to attend the Meetings is therefore advised to return the registration form immediately.

In view of the wide range of events and the unusually high attendance that is expected, some difficult problems of organization are likely to arise, and **it will not be possible to consider any applications for tickets received after 29 February.**

The Annual General Meeting of the Institute will be held on Wednesday, 6 April, 1960, and formal notice of this meeting will be sent to all members in due course.

DAVY, THE ATHENAEUM AND THE ZOO

By F. W. GIBBS, PH.D., D.SC., F.R.I.C.

News reports of the recent excavations at the Terme Suburbana near the sea-front of Herculaneum, much of which still lies buried under several yards of petrified volcanic mud from Vesuvius, provide an occasion for recalling some of the almost forgotten yet socially important of Sir Humphry Davy's activities.[1] In 1818, the year in which he was created a Baronet after his work on the Safety Lamp and on flame, Davy was commissioned by the Prince Regent (later George IV) to examine the manuscripts at Naples that had been recovered from Herculaneum, with a view to finding a way of unrolling them without damage. This difficult problem was approached on sound lines, but owing to local opposition and in the absence of tangible success, he gave up the task, thinking that in the circumstances there was little justification for continuing to spend public funds in this way.

Davy was then at the height of his fame; his reputation on the Continent can be gauged from the fact that he was well known to several royal families, and his name appears in many journals and diaries of the period. Thus a little earlier than this the American educator and author, George Ticknor, recalled[2] a dinner party at the Paris home of Madame de Staël, where the few select guests were received by her daughter, the Duchess de Broglie. Sir Humphry and Lady Davy and Baron Humboldt were present and Ticknor mentioned that 'Humboldt was so excited by the presence of Sir Humphry Davy, that he became eloquent. . . .'

Maria Edgeworth the novelist, sister-in-law of Dr Thomas Beddoes (who gave Davy the chance to make his talents known at the Medical Pneumatic Institution, Clifton) later talked with Davy about his visit to Herculaneum.[3] She wrote:

'Among other good things which Sir Humphry accomplished in his travels was the abolition of the *corda*, of ancient use in Naples,—an instrument of torture by which the criminal was hung up by a cord tied round his joined wrists, and then pulled down and let fall from a height, dislocating his wrists to a certainty, and giving a chance of breaking his arms and legs. This instrument chanced to be set up near the hotel where Sir Humphry and Lady Davy resided: they could not bear the sight, and changed their lodgings. The next time Sir Humphry was at Court the King asked why he had changed his residence. Sir Humphry explained, and expressed himself so strongly, that he awakened dormant Royal feeling, and this instrument of torture was abolished.'

Davy was known not only to the Regent in London, but also to his estranged wife Caroline, then living at Naples. Davy had represented to her that here was an opportunity to do good and to make herself 'deservedly popular. She was struck with the idea at the time, but forgot it; and then Sir Humphry took it up, and with the assistance of the public opinion of all the English, it was accomplished.'

Vase presented by Alexander I of Russia

In his will, Davy referred to some plate given him by the Emperor of Russia,[4] but his biographers fail to explain its presence among his effects. Maria Edgeworth, however, says[5] that Davy esteemed Alexander I as the 'most really noble-minded and the least ostentatious' of all the royalty he had met. 'A vast number of his munificent gifts to men of letters are known only to those by whom they were received. He has frequently sent tokens of approbation to scientific men in various foreign countries for inventions in arts and sciences which he had found useful in his dominions. A *caisse* arrived from Russia for Sir Humphry, which he thought were some mineralogical specimens which had been promised to him; but on opening it there appeared a superb piece of plate, with a letter from the Emperor of Russia presenting it to him, as a mark of gratitude for the safety lamp. The design on the plate, the Emperor adds, was his own: it represents the genius of fire, with his bow and arrows broken' (*see* photographs). This silver-gilt vase came into the

possession of Sir Humphry Davy Rolleston who lent it to the Royal Geological Society of Cornwall, and it was on exhibition in Penzance for some years before the second world war. Rolleston died during the war, bequeathing the piece to the Royal Institution, where it now is.

Davy was the first person to be approached by John Wilson Croker, M.P., Secretary to the Admiralty, in March, 1823, with his proposal for a new London club —eventually known as the Athenaeum—for the exclusive benefit of men of letters and artists. 'I thought of it,' wrote Croker,[6] 'because the University Club, the Travellers, the United Service, and such other clubs, had superseded and destroyed the old coffee houses, and I considered that literary men and artists required a place of rendezvous also.'

Davy, it should be remembered, qualified under both heads. His scientific writings and his propensity for composing verse in praise of the beauties of nature, some of which had been published, were widely known. He had even been allowed to touch up one of Southey's poems for the press, and was on friendly terms with Coleridge, Wordsworth, Scott and others. He was fond of sketching and his later work, *Salmonia*, was illustrated with engravings done from his own drawings of landscapes and fish. Davy replied[7] to Croker that in his view it should be a scientific as well as a literary club and added: 'I see no reason for excluding Judges, Bishops, and Members of both Houses, none of whom can perform their high duties without a competent knowledge of literature.'

The design commemorates Davy's invention of the Safety Lamp ('the genius of fire, with his bow and arrows broken')

Davy, by reason of his social contacts and as President of the Royal Society, entered with enthusiasm into the task of finding members. His active part in founding the Club is clear from the wording of the original prospectus, for not only was it not stated to be for the exclusive benefit of men of letters and artists, but science was mentioned first.[8] 'This Club has been instituted for the association of individuals known for their scientific or literary attainments, artists of eminence in any class of the fine arts, and noblemen and gentlemen distinguished as liberal patrons of Science, Literature or the Arts.' The first meeting of the Committee was held in the apartments of the Royal Society in February, 1824, when some 80 names were submitted to the Committee. Michael Faraday had been persuaded to act as temporary secretary and sent out the letters of invitation. On relinquishing this task a few months later, Faraday was thanked in a practical manner by being made a member of the club.

In this way the Athenaeum came into being, and the first list of members, drawn up in 1824, contained 506 names, including those of seven future Prime Ministers—among them Canning, Wellington, Peel and Palmerston —and no fewer than 169 Fellows of the Royal Society. This does not seem to bear out suggestions that Davy was not very popular as President of the Royal Society. The list shows the careful selection that was made and the great willingness of the men of eminence who were approached to become members of the new club. So successful was it right from the start that in December, 1824, the membership limit was raised to 1,000. The three Trustees of the Athenaeum were Davy (as P.R.S.), together with the Presidents of the Royal Academy and the Society of Antiquaries. As a trustee, Davy was nominally a member of the Building Committee, but he had died before the Athenaeum's own house was ready for occupation in 1830.

This was by no means the only venture on which Davy's help was requested and gladly given. Not long afterwards he was approached by Sir Stamford Raffles (Raffles of Singapore or Raffles of the Eastern Isles, and a noted naturalist) with a plan,[9] equally to Davy's liking, for the formation of a Zoological Society 'which should combine with the pursuit of science the introduction and domestication of such quadrupeds, birds, and fishes, as might be most likely to prove useful to agricultural and domestic purposes.'

In April 1825 Raffles endeavoured to interest others in the proposal, and wrote: 'I am much interested at present in establishing a grand Zoological collection in the metropolis, with a Society for the introduction of living animals, bearing the same relations to Zoology as a science, that the Horticultural Society does to Botany. . . . We hope to have 2,000 subscribers at £2 each; and it is further expected we may go far beyond the Jardin des Plantes at Paris. Sir Humphrey [*sic*] Davy and myself are the projectors; and while he looks more to the practical and immediate utility to the country gentlemen, my attention is more directed to the

scientific department.' Later on Raffles and Davy did not see eye to eye as to the share science was to have in the venture, but Davy did his best to give it a good start. In April he gave Raffles the first list of names of those wishing to support his further efforts. 'Mr Peel's name is at the head of the list, and those of Lord Spence, Lord Lansdowne, Lord Stanley, Mr Heber, and many others of weight follow.' Their work was successful; grounds were secured in Regent's Park and the zoological collection, partly made up by gifts from interested subscribers, was opened to the public in 1828.

The photographs used to illustrate this article were specially taken by Miss Jean Mason of the Royal Institution and are reproduced by kind permission.

REFERENCES

1. T. E. Thorpe, *Humphry Davy: Poet and Philosopher*, London, 1896, v.
2. George S. Hillard, *Life, Letters and Journals of George Ticknor*, London, 1876, i, 128.
3. A. J. C. Hare, *The Life and Letters of Maria Edgeworth*, London, 1894, ii, 144.
4. J. A. Paris, *The Life of Sir Humphry Davy*, London, 1831, ii, 463.
5. A. J. C. Hare, *op. cit.*, 143.
6. Humphry Ward, *History of the Athenaeum 1824–1925*, London, 1926. *See* chapter I.
8. Louis J. Jennings, *The Croker Papers*, London, 1885, i, 256.
8. [Athenaeum Club], *Copy of the First published List of Members* (1824), London, 1882.
9. [Lady Raffles], *Memoir of the Life and Public Services of Sir Thomas Stamford Raffles, by his Widow*, London, 1830, 589–593. For the part played by the Zoological Club of the Linnaean Society (founded 1823 and dissolved 1829), see *A Short History of the Zoological Society of London*, 1901, 147.

THE INSTITUTE RESEARCH DIPLOMA

For some eighty years, since the time the Institute first imposed a stiff practical examination that was intended to distinguish between the arm-chair scientist and the genuine chemist, the Institute's qualifications (particularly by direct examination) have been held in high esteem. It was perhaps natural that some of those early Associates, who had been trained in courses recognized as of adequate standard, and who were acknowledged to have more than average practical and manipulative skills, should have turned to research, either in the course of their employment or from choice. To fulfil their ambition, some of these looked to the universities of the U.K. and the Continent and, though lacking a first degree, hoped to obtain some higher qualification, such as a Ph.D. of a British or German university. The first such liaison between the Institute and a university that has so far been traced in the *Proceedings* of the Institute occurred more than half a century ago; in 1907 Leipzig University announced that it had accepted the A.I.C. and the F.I.C. as equivalent to the B.A. and the B.Sc. degrees for the purpose of admission to studies leading to the Ph.D.

Since then a good number of Associates and Fellows —how many we do not know—who obtained the A.I.C. (later A.R.I.C.) by examination have worked for and secured higher degrees of most universities in the U.K. and some overseas. At present several Graduate Members and Associates are so engaged in various parts of the country. But this number cannot be very considerable at any time. For its external degree, the University of London does not admit for research a student who lacks a first degree of London. Elsewhere, before a higher degree can be awarded, the residential requirements must be satisfied, and this generally means a minimum of three years of full-time internal work, with a comparatively large financial outlay and perhaps some risk, such as possible loss of seniority on returning to a former place of employment.

Since the second world war the number of young men wishing to secure a recognized award indicating training and competence in research has notably increased. But for many reasons the majority of them cannot hope to receive a Ph.D. degree once they leave their university or college for employment. In nearly all universities, no machinery exists for the assessment of work done outside, except at a few institutions that have close links with the university itself. Thus frequently it is as difficult for a university graduate as for a Graduate Member (by examination) of the Institute to secure any qualification in research, though work of high quality is being done by many such men and women in technical colleges, in industry, in Government service and in some other fields of employment. The Council believes that the Institute is the only appropriate independent body competent to judge such work—confidentially if necessary—and to declare when it merits consideration as equivalent to that of a university Ph.D. degree. (The M.C.T. is intended to be a rather different type of qualification; *see* p. 38.)

Such a scheme is admittedly ambitious and, to be successful, many safeguards must be imposed. The general nature of the award can be seen by perusing the Regulations issued last month (*J.*, 1959, 707); it is proposed to amplify these later with 'Notes for Guidance,' based on experience gleaned in operating the scheme. There need be no doubt that, to ensure the success of the scheme, a high standard will be imposed.

Only Fellows, Associates and Graduate Members will be eligible for the award, and we therefore take this opportunity to remind graduates of British universities that a good honours degree in chemistry exempts them from the examination for Graduate Membership and admits them directly to that grade. All who are interested are advised to obtain a (gratis) copy of the *Regulations for Admission to Membership* from the Assistant Registrar, 30 Russell Square, W.C.1.

PHYSICS IN THE SERVICE OF CHEMISTRY

ABSORPTION SPECTROPHOTOMETRY

IN THE ULTRA-VIOLET AND VISIBLE REGIONS

By R. A. MORTON, PH.D., D.SC., F.R.I.C., F.R.S.
Johnston Professor of Biochemistry, University of Liverpool

Research in the field of absorption spectra, alike for the ultra-violet, the visible and the infra-red regions, owes much to a distinguished line of workers who successively made improvements in technique. Many advances were connected just as much with emission spectra as with absorption spectra, and the development of improved prism and grating spectroscopes and the accurate determination of wave-lengths are now part of the history of physical science. The use of prisms of glass or quartz, fluorite or rock salt, permitted the study of different spectral regions. Light sources such as low-voltage carbon arcs, or high-tension sparks between metallic electrodes in air, were rich in ultra-violet radiations, and the spectra obtained with quartz prism instruments could be photographed. The gelatin–silver bromide emulsion evolved by R. L. Maddox (1871) was in itself a real advance which the appearance of commercial dry plates (Kennet, 1874) did much to consolidate. Steady improvements in photographic development processes (hydroquinone 1880, metol 1891, sodium sulphite 1882) led to better negatives.

The ordinary dry plate is sensitive over the region 220–500 mμ, *i.e.* it can be used for a wide range of ultra-violet radiations but only for a part (400–500 mμ) of the visible spectrum. Almost from the start (*e.g.* Vogel 1873), small quantities of dyestuffs were introduced into the photographic emulsion in order to push the sensitivity beyond 500 mμ in the direction of longer wave-lengths. 'Orthochromatic' plates were sensitive to as far as 600 mμ and 'panchromatic' plates to 680–700 mμ. The celluloid film of Eastman (1889) was of course enormously successful in photography generally but spectroscopists remained very faithful to glass plates until perhaps the end of the second world war, more than 50 years later.

The first clear account of an absorption spectrum was given by Sir David Brewster in 1834 when he described the bands shown by extracts from leaves, bands which we now attribute to chlorophylls and carotenoids.

Over a century ago Sir G. G. Stokes[1], using a fluorescent screen, showed that sunlight dispersed by means of a quartz spectroscope had no radiations of wave-length shorter than about 300 mμ, whereas the different electric sparks emitted line spectra including much shorter wave-length radiations—indeed he detected a pair of lines at 185 and 186 mμ in the high-tension spark between aluminium electrodes. This was actually very near the short-wave transmission limit of quartz. To go beyond 185 mμ in the direction of shorter wave-lengths it is necessary (*a*) to use a fluorite prism (transparent to about 120 mμ), (*b*) to evacuate the whole apparatus, because air absorbs wave-lengths below 200 mμ, and (*c*) to use a special type of photographic plate (Schumann plate) with a minimal amount of gelatin in the emulsion. The spectral region beyond 185 mμ has considerable interest for the study of small molecules but is at present less serviceable for work on larger organic molecules.

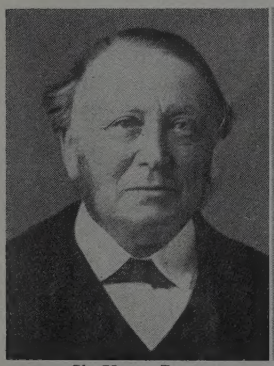
The spectra of light sources such as arcs between carbon electrodes or 'Pointolite' electric lamps, are characterized by continuous spectra in the near ultra-violet and visible regions. By interposing a solution of, *e.g.*, potassium permanganate between the light source and the spectroscope, several rather narrow regions or bands of selective absorption can be seen with a visual spectrometer or photographed with a spectrograph. Most of the arcs or sparks between metallic electrodes exhibit line spectra; these are less suitable than continuous spectra for revealing fine structure in absorption by vapours or solutions. Resolved absorption spectra are particularly characteristic of organic compounds in the gaseous state, *e.g.* benzene, phosgene and pyridine, and the detailed analysis of such spectra (Henri, Ingold and others) has been of great value to chemical theory.

The earliest truly continuous ultra-violet light sources to be used regularly were high tension ($1{\cdot}0$–$1{\cdot}5 \times 10^4$ v) sparks running under water. These were noisy and erratic. More effective, but equally rowdy, was the high-tension spark running under water between tungsten electrodes and activated by a Tesla coil ($2{\cdot}5$ to 5×10^5 v). The earliest of these light sources to be used in England was set up in the Liverpool laboratory of E. C. C. Baly by W. R. Brode in 1928 during his visit as a Guggenheim Fellow. The apparatus, carefully maintained, gave good service for about 14 years. When in use it probably interfered a good deal with radio reception! Early in the last war it had for this reason to be electrically screened by enclosing it in a wire cage.

A special type of hydrogen discharge tube devised by Bay and Steiner[2] also gave a good continuous spectrum extending to 210 mμ. This light source, though silent and fairly intense, was cumbersome, inconvenient and not very reliable. It was, however, the precursor of the present-day hydrogen lamp[3] (Munch, 1935) which is neat and compact and has a long life. Indeed (apart from its price) it is well-nigh perfect for modern photo-

electric instruments. It must, however, be remembered that the earlier under-water sparks and the original hydrogen discharge tubes needed to be intense light sources because they were used in ultra-violet spectrography where recording was made on photographic plates of dimensions 10 in. × 4 in. With the advent of photoelectric cells and photomultipliers the intrinsic light intensity of a spectrophotometric source no longer needed to be high; indeed low intensity had advantages.

The early history of absorption spectroscopy was very strongly influenced by workers from the British Isles. The language of spectrophotometry—in the form of a general theory of the absorption of radiation—is associated with the names R. Bunsen and (Sir) H. Roscoe,[4] and although the manner of presenting absorption spectra data has since gone through interesting phases,[5] the foundations were firmly laid.



Sir Henry Roscoe
1833–1915

Sir W. N. Hartley
1846–1913

Sir W. N. Hartley (1846–1913) was the pioneer of photographic absorption spectroscopy. When he left Edinburgh in 1864 it was with the intention of working with Bunsen at Heidelberg. On his arrival there he found every place taken and his *arbeit* was actually carried out under Kolbe at Marburg. In 1877 Hartley applied the then new dry-plate photography to the purpose of studying absorption spectra, and his first paper[6] was akin to a surveyor's 'run over the ground'; it included the important observations that water, methanol and ethanol were 'diactinic,' *i.e.* transparent down to 200 mμ, and therefore excellent solvents for absorption spectroscopy. For those wishing to follow the historical development of the subject, Kayser's *Handbuch der Spektroscopie*, Vols. iii and iv (1905, 1908) is invaluable. Baly's *Spectroscopy* (first published in 1905; second edition 1912, reprinted 1918) shows how Hartley's work was regarded by one of his distinguished successors:

> 'By far the most valuable work in this direction has been carried out by Hartley in his investigations upon ultra-violet absorption spectra; here, undoubtedly, have been discovered certain most important facts connecting chemical constitution and absorption spectra; and, further, it appears that we possess, thanks to Hartley, a most searching method of studying generally the whole question of constitution. The constitution of many bodies, when chemical methods have failed, have been undoubtedly established by this means, and it is not too much to hope that the whole question of molecular structure of organic compounds may be solved in this way.
>
> The beauty of Hartley's method chiefly lies in the method of expressing the results obtained; he has not merely examined the position of the absorption bands or the limits of absorption, at some definite concentration of solution, but has measured the absorption limits at a great many concentrations, always increasing the dilution step by step until complete transmission is obtained. The oscillation frequencies of the edges of the regions of absorption are then plotted against the corresponding strengths of solution, and a curve drawn through the points so obtained. It is the shape of these curves which have been connected with the chemical constitution.'

In 1879 Hartley moved to the Royal College of Science at Dublin where most of his spectroscopic work was done. For 20 years he studied the relations between the molecular structure of carbon compounds and their absorption spectra in the ultra-violet. In retrospect, Hartley's main handicap was an inability to determine quantitatively the intensity of absorption at particular wave-lengths; he lacked an adequate photometric device. By investigating the limits of absorption at different concentrations he made a rather rough approach to what we should now call an absorption curve. This approximation was not good enough to settle the questions which occupied Hartley's mind—identifying alkaloids, proving which of two plausible structures was correct and establishing the 'relationship between benzene, naphthalene and anthracene in terms of "invisible" or ultra-violet colour.'

Hartley (and his successors for perhaps 30 years) may not have known about the work of K. Vierordt (published at Tübingen in 1873 and 1876) in devising a slit photometer by means of which quantitative determinations of absorption spectra were made possible. If Vierordt's instrument had been widely known and its value correctly assessed, the early work on photographic absorption spectroscopy would probably have been different and progress would have been more rapid.

Sir J. J. Dobbie (1852–1924) held the Chair of Chemistry at Bangor, North Wales, from 1884, and in 1898 collaborated with Hartley in a much-quoted investigation on the structure of carbostyril, 'methyl pseudocarbostyril' and methyl carbostyril[7]. This was followed[8] by a similar investigation on *o*-oxycarbanil. The fact that these investigations were defective by the standards of quantitative spectrophotometry is not now important;

they illustrated a new approach to structural problems, and very many chemists sensed that it had great promise.

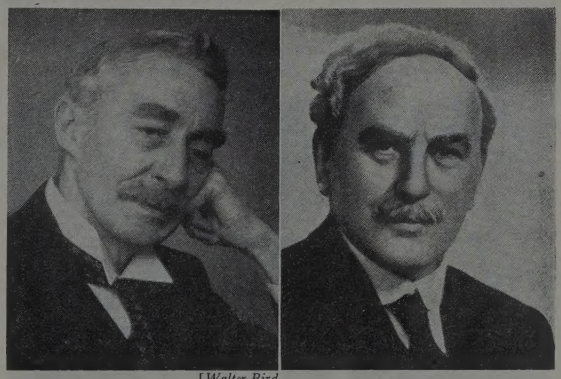
Dobbie became Government Chemist in 1909 and found time to maintain his interest in spectroscopy. His successors Sir R. Robertson and Sir J. J. Fox kept up this interest. With Fox, Dobbie carried out further studies on the spectra of alkaloids and later made noteworthy contributions to the spectra of elements in the gaseous state.

E. C. C. Baly (1871–1948) became aware at an early stage in his career of the need for improved technique, and a paper with Desch[9] described an adjustable cell for studying different thicknesses of a solution of constant concentration. An improved method of plotting results was devised whereby the logarithms of thicknesses of solution of constant concentration were shown against the wave-lengths of light absorbed. Baly and Desch tackled the thorny questions of the structure of ethyl acetoacetate and of acetylacetone. It was concluded '. . . that the absorption band is not due to either of the two possible modifications (keto or enol) but to the oscillation from one form to the other.' About that time Armstrong and Lowry were using the phrase 'dynamic isomerism' and Baly coined the term 'isorropesis.' By 1918 (or possibly earlier) Baly had realized that absorption bands could be due to causes other than the migration of a hydrogen atom; the evidence led him to admit that his original idea 'must be modified.' During the period up to 1910 when he was at University Collge, London, Baly and his colleagues contributed a good deal to the preliminary study of absorption spectra of organic compounds. This was stimulating and interesting work although it was not nearly so finished as Baly's classical measurements on the emission spectra of the inert gases isolated by Ramsay, Travers and others at University College. Baly possessed great energy and enthusiasm and a supple imagination, which the rather crude absorption spectra obtainable in 1900–1910 could neither fully nourish nor restrain. Had he at this period enjoyed the advantages of a sector photometer or a photoelectric spectrophotometer how different would his discussions have been!

A. Hantzsch (1857–1935) took up absorption spectroscopy about 1912 because of his interest in dyestuffs. He used the methods of Hartley and Baly and was slow to make use of the techniques which soon after the first world war began to transform the subject. One of his young pupils about this time was Sir I. M. Heilbron. The range of problems to which Hantzsch applied absorption spectroscopy was very wide and despite quantitative inadequacies many results of permanent value were obtained. This was particularly true, for example, with nitric acid in different solvents and nitrates. Hantzsch's ideas on solvent–solute interaction became widely accepted. A notice[10] about him which appeared in 1936 contained the following sentences :—

'Hantzschs Feuergeist brachte es mit sich dass seine Vorstellungen erst im Verlauf mehrerer Publikationen ausreiften. Dies und die schon betonte Tatsache, dass er die physikalisch-chemischen Methoden nicht mit überflüssiger, sondern mit der für seine Zwecke erforderlichen Genauigkeit anwandte, führte das öfteren zu Polemiken . . . in denen man den eigentlichen Kern seiner Arbeiten übersah.'

The sector-photometer made by Hilger in about 1920 was designed by Twyman, and it is not too much to claim that by its means absorption spectra studies in the ultra-violet were revolutionized. (V. Henri was a notable pioneer in the use of a rather simpler sector photometer.) It was described by Twyman and Allsopp as follows :[11]



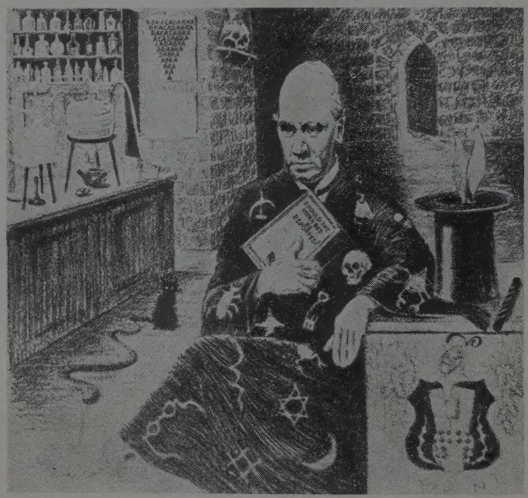
[*Walter Bird*

Prof. E. C. C. Baly 1871–1948 — Sir John Fox 1874–1944

'Immediately in front of the slit of the spectrograph is a bi-prism which receives the light from the source in the following manner. The light emanates from the source and may reach the slit by two alternative paths. An upper beam passes through a wedge prism. The beam then passes through a rotating sector, the aperture of which can be varied and, falling on the bi-prism, is deviated by the lower half of that prism to pass axially along the collimator of the spectrograph. The second beam traverses first the absorbing liquid under examination, contained in a suitable cell, then through another wedge prism similar to the former one but so arranged as to divert the light upwards instead of downwards, and a rotating sector of fixed aperture. The beam is then diverted by the upper half of the bi-prism, and passes axially along the collimator of the spectrograph like the first. We thus have two beams fed into the spectrograph, the one capable of being varied in intensity at will by varying the aperture of the rotating sector, the other subject to the absorption of a known thickness of the liquid under examination. A series of photographs is taken on a single photographic plate with the variable sector set to different apertures. Each of

these photographs consists of a pair of spectrum photographs in close juxtaposition, one of which is of reduced density throughout its whole length, the other—that which has passed through the material under test—being more dense than the first in certain parts and less so in others, there being certain wave-lengths where the densities of the two are equal. The places of equal density of blackening being spotted, everything necessary is known for the plotting of the absorption curve.'

Hilger sector photometers became widely used. The majority of them were short-focus instruments designed for use with spark light sources a few inches distant from the photometer. A number of long-focus sector photometers were made (at the request, I believe, of the Liverpool School) for use with arcs between metal electrodes. A combination of iron and nickel electrodes worked well with a distance of about 1 metre between the source and the photometer.



Sir Robert Robertson, 1869–1949
A cartoon drawing by Mr Charles Sutton, Officer of Customs and Excise, in the 1920s

Owing to 'fortunate compensation,' sector photometry gave reproducible and surprisingly accurate results, in spite of the 'errors' associated with intermittency of exposures in blackening of the developed photographic plate. I recollect a visit paid to Baly's laboratory in the twenties by Professor Fritz Weigert when he was very sceptical about the accuracy attainable in measuring intensities of absorption. He arranged with Professor H. v. Halban for us to measure the intensities of absorption at various wave-lengths shown by a thin piece of glass already studied by the latter, using a newly designed photoelectric photometer. The findings of v. Halban were not disclosed until the photographic results had been obtained. The agreement turned out in fact to be very good.

Among the early users of the sector photometer was F. O. Rice. Working under Baly at Liverpool he produced a most convincing account of the ultra-violet absorption spectra of ketones.[12]

Henri and his colleagues, in *Etudes de Photochimie* (1919) studied systematically the spectra of simple molecules; they realized the importance of 'absorbing' or 'chromophoric' groups and showed how two such groupings would exert their effects almost independently unless they were conjugated. As time went on much useful information was added from the laboratories of Baly and Henri. Both these distinguished workers essayed comprehensive interpretations of ultra-violet and infrared spectra prematurely, but much of the information gained in their studies proved permanently valuable.

The sector photometer found a competitor in an instrument designed by Judd Lewis but both began to be replaced about 1931–32 by the 'Spekker' photometer[13] which was not only a theoretically sounder instrument but also did its work in half the time.

Photoelectric spectrophotometry[14] offered a new level of accuracy, and, even as early as 1922, v. Halban and Eisenbrand claimed for it a sensitivity 100 times as great as that of the photographic method. Excellent results were certainly obtained, and soon after the second world war it became clear that closely reproducible measurements could be made in different laboratories with photoelectric spectrophotometers.

The Beckman Photoelectric Spectrophotometer (Model DU) introduced early in the war years was a brilliantly designed general-purpose instrument. After the war it quickly displaced the photographic method for routine absorption studies. The Unicam and Hilger Uvispek instruments similarly met the needs of the British market. Recording spectrophotometers have appeared, and, starting from the Hardy instrument devised at the Massachusetts Institute of Technology well before the war, a number of excellent commercial models (Cary, Optica, Unicam, Hilger, etc.) are now available. Today there is no difficulty in measuring absorption spectra with considerable precision on both the wave-length scale and on the intensity scale.

Recognition of the usefulness of ultra-violet absorption spectra of organic compounds came but slowly. In the period 1920–30 some physical chemists, rightly impressed by the elegant interpretation then emerging of molecular spectra obtained with simple di- and tri-atomic substances, were repelled by the empirical nature of the work on larger molecules in solution. They regarded such investigations as naïve and fundamentally unpromising. When the experimental data displayed good vibrational structure, as for example in carbon disulphide, benzene and pyridine vapours, they stressed the enormous difficulties in the way of complete interpretation. At the time, such a pessimistic attitude was not wholly unreasonable. Moreover, there were sound organic chemists, then and later, who doubted whether absorption spectra could be *really* useful to them. In

academic circles there was even a feeling that any unexpected aid given by spectroscopic studies was only just legitimate and never quite rigorous. Here again it is possible to sympathize with an outlook which had a quantum of reasonableness, though backward-looking.

A number of independent developments in various countries brought about a changed attitude. Studies on the absorption spectra of inorganic compounds, including halides and halogens, in solution and as vapours, showed that absorption data could be fitted satisfactorily into the main corpus of expanding inorganic and physical chemistry; the narrow bands seen, *e.g.* in permanganate spectra, could be interpreted, and the position on the wave-length scale could be ascribed to particular electronic transitions.

In organic chemistry a pattern of chromophores had emerged, and the effects of conjugation on the positions and intensities of bands could be reduced to order. The empirical element in interpretation steadily became less prominent. The techniques available were now adequate and much trustworthy information was collected and collated. The more exuberant kind of speculative interpretation then went out of fashion, and if there was less lively controversy there was steady consolidation.

These changes do not, however, suffice to explain how, in a short space of time, absorption spectra studies became a normal aspect of the work of most research and testing laboratories, instead of being restricted to a small number of specialized groups. The answer lies partly in a new attitude towards relatively costly scientific equipment; more money spent on apparatus encouraged improvements in design, and these led to better results, which in turn helped to justify the expenditure. It can also be said that some striking applications captured the imagination of chemists and their employers.

The part played by spectroscopy in the study of pro-vitamin D was a case in point, for it was difficult to imagine this advance being made in any other way. There was on one hand the phenomenon of 'activation' of cholesterol by ultra-violet light and, on the other, the recognition of an 'impurity' as the photochemical precursor of vitamin D. The characteristic spectrum later proved diagnostic of a specific unsaturated grouping in the sterol ring system. This led to a comprehensive study of absorption spectra in the steroid field with the eventual construction of a pattern which is intellectually satisfying—complicated enough to be interesting and rich enough in detail to be very serviceable.[15]

Similarly the discovery of the absorption spectrum of vitamin A led to the gradual replacement of tedious and rather approximate biological assays by spectrophotometric determinations. These, too, had defects which were far from negligible. In the end, a combination of preparative methods and correction procedures overcame most of the difficulties. In the course of the work it was widely realized that the improved accuracy which resulted from the replacement of photographic methods by photoelectric methods could be put to service so that absorption curves distorted by irrelevant absorption might be corrected by simple geometric procedures. The Morton–Stubbs correction procedure for vitamin A has been followed by many variants applicable to different problems.

Another aspect of ultra-violet spectrophotometry is seen in the study of two-component systems in which all curves pass through isosbestic points. Thus the absorption curves for pyridoxine in aqueous solution change with pH over the range 2–7, isosbestic points occur at 266 and 304 mμ, and the proportions of the cation and the zwitterion can be calculated. Another two-component system (zwitterion–anion) with new isosbestic points is seen when the pH is between 7 and 14. From the spectra at different pH values the two pK_a constants can be ascertained.[16]

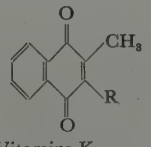
In unsaturated compounds the importance of conjugation was realized early and was later followed up in detail.[17] In a series of polyenes, $CH_3(CH{=}CH)_nCHO$ for example, the absorption is displaced in the direction of longer wave-lengths for each increase in n. The oscillator strength

$$f = \int_{\nu_1}^{\nu_2} \epsilon \, d\nu$$

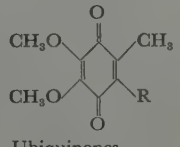
(*i.e.* the integral of the molecular extinction values over the frequency range of the band) is directly proportional to the number of double bonds. Lewis and Calvin (1939) found that an equation $\lambda^2 = An + B$ applied to polyene series when A and B are constants and λ represents the wave-lengths of absorption peaks.

A vast amount of systematic work has been done on aromatic compounds and on various groups of heterocyclic compounds, but this does not lend itself to summary treatment.

Spectrophotometric methods can be used in determining molecular weights of pure substances. Thus in the vitamins K the absorbing part of the different forms is always the same, but optically transparent side-chains occur in vitamin K_1 (phytyl $C_{20}H_{39}$) and vitamins K_2 ($C_{30}H_{49}$, $C_{35}H_{57}$, $C_{45}H_{73}$), polyisoprenoid chains with unconjugated double bonds. Similarly the



Vitamins K
R = phytyl, $C_{30}H_{49}$, $C_{35}H_{57}$, $C_{45}H_{73}$



Ubiquinones
R = $-(C_5H_8)_nH$.
n = 6 – 10

ubiquinones have identical molecular extinction coefficients, and as the side-chain grows longer so the weight of dissolved substance needed to display a given intensity of absorption must increase.

Again if a new substance is transparent in the visible or near ultra-violet region, but possesses a grouping

such as OH, COOH, CHO or NH_2, it can be converted into a conjugated derivative of a compound with a characteristic absorption peak of known intensity. Alternatively the new substance may possess a reactive chromophoric grouping which on combination with a transparent grouping could form a derivative of known spectroscopic properties. Examples of molecular-weight determinations by means of picrates are given by Cunningham, Dawson and Spring[18] and by means of 2,4-dinitrophenyl hydrazones by Fazakerly and Glover.[19]

Another aspect of spectrophotometry involves the measurement of difference spectra. Thus in studying visual pigments, photolabile substances can be decomposed under the action of monochromatic light. The absorption spectrum of the resultant solution is then subtracted from that of the unirradiated solution. The difference spectrum records the disappearance of an absorbing molecular species and the production of a new substance with absorption in another spectral region. In favourable circumstances a mixture of photolabile pigments can be studied by successive 'bleachings' with different monochromatic radiations.

Difference spectra can also be used to follow non-photochemical reactions involving the disappearance or appearance of absorption peaks of known origin. Perhaps the most familiar example is the study of oxidation–reduction enzyme systems involving diphosphopyridine nucleotide and flavinadenine dinucleotide. Changes in intensity of absorption apply at 340 mμ to DPN and at 450 mμ to FAD. Similarly changes at 303 mμ can be used to follow the action of coenzyme A.[20] Chance has used a cathode ray unit to record differences in optical density between aerobic and anaerobic bacterial suspensions. Absorption spectroscopy has done much to help in elucidating the series of reactions occurring in respiratory systems, and the oscillograph allows spectra to be viewed almost instantaneously.

The ultra-violet absorption exerted by proteins is due in the main to the aromatic amino acids, phenylalanine, tyrosine and tryptophan. The nucleoproteins and the nucleic acids also display ultra-violet absorption due to the pyrimidine and purine bases. There is now a very considerable body of accurate work in this field which is being extensively used.

The whole story of research into carotenoids and substances derived from carotenoids reflects the combination of many techniques, chromatography and absorption spectroscopy having played an outstanding role. Two sides to this work have been specially noteworthy; (*a*) the relationship between selective absorption and *cis-trans* isomerism and (*b*) the bearing of absorption spectra on the study of biosynthetic pathways.

An indirect application of spectrophotometry for the determination of unconjugated di- tri- and tetra-enoic acids, such as linoleic, linolenic and arachidonic acids, has been widely used. These acids display no selective absorption but the double bonds can 'shift' when the acids are heated under controlled conditions in the presence of potassium hydroxide. Thus linoleic acid can give rise to an artifact with two conjugated double bonds and exhibiting an absorption peak at 230 mμ. The process is not a stoichiometric one but it can be made a highly reproducible one under strictly specified conditions. Similarly linolenic acid, with three unconjugated double bonds, yields on alkali isomerization a mixture of products with absorption maxima at 230 mμ (conjugated dienoic acid) and 270 mμ (conjugated tri-enoic acid). Elaeostearic acid (present in tung oil), $CH_3(CH_2)_3(CH{=}CH)_3(CH_2)_7COOH$, with three conjugated double bonds, has a characteristic spectrum.

In discussing the applications of ultra-violet absorption spectra, it is tempting to emphasize natural products and particularly those of biochemical interest. Thus the spectroscopy of porphyrins, of blood pigments and of chlorophylls is itself a wide and very interesting field. At the same time the spectra of wholly synthetic compounds, and in particular of dyestuffs, represent a most important facet of the subject. The spectra of the rare earths, of ceric compounds and of uranyl compounds illustrate another facet. Finally, there is an enormous field of colorimetric analysis; in many instances methods may be enlarged in scope and accuracy by using carefully chosen monochromatic light instead of white light.

When the organic chemist of today succeeds in isolating a new product in a state of purity he has at hand several spectroscopic weapons for investigating its structure. These include absorption spectrophotometry in the visible and ultra-violet regions, infra-red and Raman spectroscopy, and now nuclear magnetic resonance spectra. Experience still counts in all these fields, and much remains to be done in collating the ever-increasing stock of information. Perhaps, however, the most noteworthy aspect of the present situation is the way one approach can supplement and assist another.

REFERENCES

1. Stokes, *Phil. Trans.*, 1852, **142**, 463; *ibid*, 1862, **152**, 599.
2. Bay and Steiner, *Z. Physik.*, 1929, **59**, 48.
3. Allen, *J. opt. Soc. Amer.*, 1939, **29**, 453.
4. *Annalen der Physik und Chemie*, 1857, **101**, 235.
5. Brode, *J. opt. Soc. Amer.*, 1949, **39**, 1022.
6. Hartley and Huntington, *Phils. Trans.*, 1879, **170**, 257.
7. *J. chem. Soc.*, 1899, **75**, 640.
8. *Ibid*, 1900, **77**, 839.
9. Baly and Desch, *J. chem. Soc.*, 1904, **85**, 1039.
10. *Z. Elektrochem.*, 1936, **42**, 3.
11. Twyman and Allsopp, *The Practice of Absorption Spectrophotometry*, Second Edition, 1934, pp. 70–1.
12. Rice, *Proc. Roy. Soc.* A, 1914, **91**, 76.
13. Twyman, *Trans. Optic. Soc.*, 1931–32, **33**, 1.
14. v. Halban and Siedentopf, *Z. physikal. Chem.*, 1922, **100**, 208; Hogness, Zscheile and Sidwell, *J. phys. Chem.*, 1937, **41**, 379.
15. Dorfman, 'Ultraviolet absorption of steroids,' *Chem. Rev.*, 1953, **53**, 47.
16. Lunn and Morton, *Analyst*, 1952, **77**, 418.
17. Hausser *et al.*, *Z. physikal. Chem.*, 1935, **29B**, 371.
18. Cunningham, Dawson and Spring, *J. chem. Soc.*, 1951, 2306.
19. Glover, in *Modern Methods of Plant Analysis*, Volume 1. Edited by Paech and Tracy, 1956, p. 207.
20. Chance, *Rev. Sci. Instrum.*, 1951, **22**, 619; *Nature*, 1952, **169**, 215.

PROGRESS IN ORGANIC FLUORINE CHEMISTRY*

By M. STACEY, PH.D., D.SC., F.R.I.C., F.R.S.
Mason Professor of Chemistry, University of Birmingham

The holding of an International Symposium on Fluorine Chemistry (at Birmingham, in July, 1959) shows that this young branch of Chemistry is now fully grown. More than 50 papers were presented by the world's leading fluorine chemists from 25 different countries, and almost all aspects of the subject were reviewed.

On the organic side, fluorine compounds are making an impact both in fundamental chemistry and on the industrial front.

In order to make substances of industrial importance, such as the chlorofluoromethanes and chlorofluoroethanes for refrigeration and aerosol purposes, reliance has always been placed on halogen exchange methods. As industrial applications increase, these methods will grow in importance. They, and addition of HF to unsaturated compounds, *e.g.* to olefins, are of importance in making the chemical intermediates for the production of fluorine-containing polymers, such as polytetrafluoroethylene and polychlorotrifluoroethylene and their co-polymers. An electrochemical fluorination method developed by Simons is of great potential importance for the preparation of some types of compound, especially for fluorinated long-chain acids.

In order to make highly-fluorinated carbon compounds it is necessary to use elementary fluorine itself in some process where the violence of the reaction with the carbon compound can be moderated. Such methods involve the use of an inert diluent gas and a higher metallic fluoride, such as CoF_3.

A very extensive investigation has been carried out on the fluorination of benzene over a bed of CoF_3 at about 250°C. The product usually crystallized partially, although nearly 20 compounds have been separated from it. This has led to the isolation of a new class of highly fluorinated cyclohexanes, cyclohexenes and cyclohexadienes, either directly or by dehydrofluorination treatment with alkali.

The successful separation of these compounds has been due to the use by Professor J. C. Tatlow of gas–liquid partition chromatography on a preparative scale.

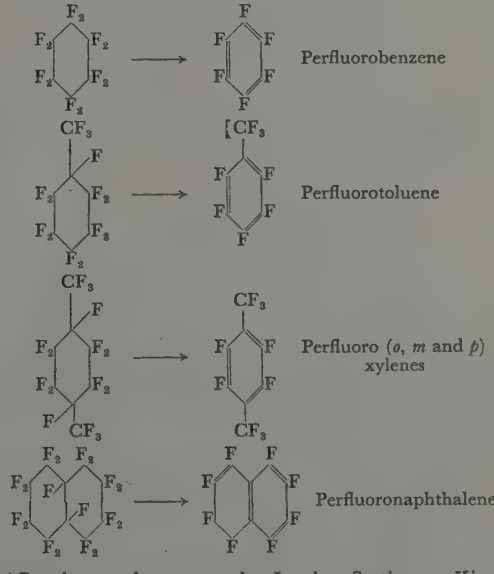
Fluoro-organic compounds are characteristically very volatile, and isomers have boiling points close to each other; the most troublesome feature of all is that they form stubborn azeotropes.

In the gas–liquid partition chromatography method discovered by James and Martin, the volatile mixture in a stream of nitrogen as carrier gas is passed through a tube filled with a non-volatile liquid absorbed on a solid packing. Owing to differences in the partitions of components of a mixture between the gas and the liquid–solid mixture, separation is effected. Amounts of 50–100 g have been separated in the apparatus in a single run.

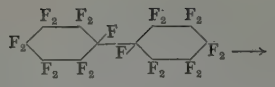
The fluorocyclohexenes were identified by infra-red characterization and by oxidation to known dibasic acids, such as perfluoroadipic and perfluorosuccinic.

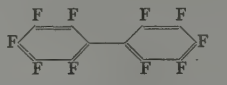
These dibasic acids were synthesized and characterized by independent routes. They form good initial material for the synthesis of fluoropolyamides and polyesters, though so far these appear to be too unstable to alkali to be of value. The dibasic acids can be reduced to the corresponding alcohols.

The fluorocyclohexadienes were also identified by infra-red measurements and by oxidation to dibasic acids. Further treatment of certain of the unsaturated diene compounds led to the formation of hexafluorobenzenes. A new method of preparing this substance and other perfluoroaromatic compounds has been discovered. This involves the pyrolysis of perfluorocyclic compounds over nickel gauze at 350–650°. The following conversions have been carried out:



* Based on a lecture to the London Section at Kingston Technical College on 5 February, 1959.

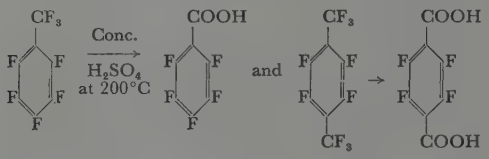




The yields were about 50 per cent.

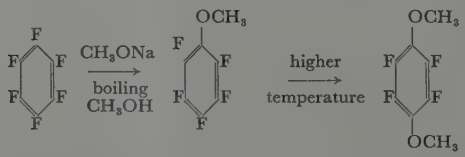
The aromatic fluoro compounds offer a new field for exciting chemistry, and some reactions studied are as follows:

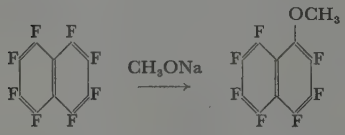
Side-chain trifluoromethyl groups can be hydrolysed to carboxyls, thus:



The yields were 50 per cent.

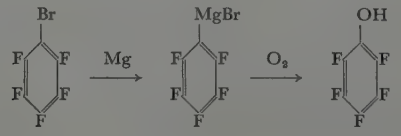
Fluorine in the nucleus can be substituted by methoxyl:



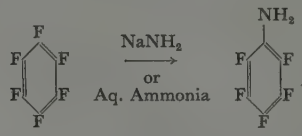


Anhydrous $AlCl_3$ converts the OCH_3 groups into phenolic groups:

A superior method for preparing the phenols is to begin with perfluorobenzene and to replace a nuclear fluorine atom directly by hydroxyl, with KOH in tertiary butanol as reagent. Alternatively a Grignard reagent may be treated as follows:

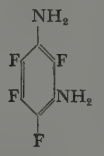


A nuclear fluorine atom in C_6F_6 can also be replaced by amino groups on treatment with sodamide or with ethanolic ammonia to give pentafluoroaniline:



Also C_6F_6 reacts with hydrazine to give pentafluorophenyl hydrazine. Likewise pentafluorobenzene C_6F_5H reacts analogously to give the 2,3,5,6-tetrafluoro compounds.

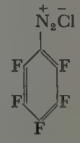
More drastic treatment of pentafluoroaniline with ammonia affords 2,4,5,6-tetrafluoro-*m*-phenylenediamine:



Other nitrogen-containing bases, such as hydrazine, give interesting products.

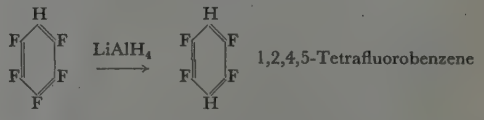
Pentafluoroaniline undergoes the usual diazo reactions, although somewhat slowly and with many side reactions.

The diazonium salt forms successfully to give



but the positive nitrogen renders the nuclear fluorine atoms very susceptible to nucleophilic attack, and they are replaced in aqueous HCl solution to some extent by hydroxyl groups and chlorine atoms. Successful diazotization can be carried out in anhydrous hydrofluoric acid, and a wide range of novel dyes is possible.

Lithium aluminium hydride acts as a weak nucleophilic agent towards pentafluorobenzene, which itself is an interesting initial material for synthesis:

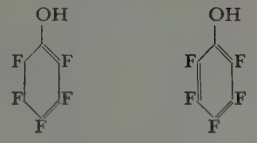


It is interesting to note that in this and other reactions of pentafluorobenzene the H atom is *para*-directing.

Other aromatization reactions have been discovered; thus C_6F_7H,

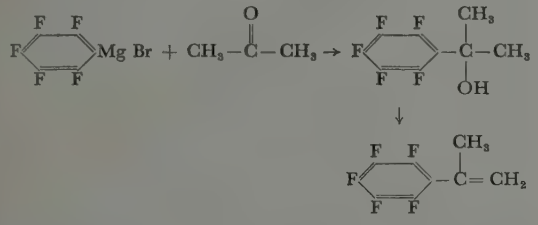
and its isomers on refluxing with

aqueous KOH will give



The isomers have been separated and tentatively identified.

Many other reactions of hexafluoro-and pentafluorobenzene are interesting, the Grignard ones particularly.

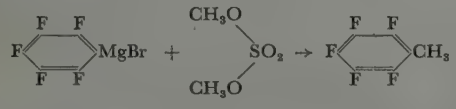


This styrene derivative will polymerize.

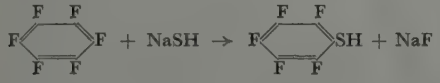
Benzaldehyde on the Grignard reagent will give pentafluorophenyl carbinol, which on oxidation will give pentafluorobenzophenone.

An interesting phenone is made by the action of lithium trifluoroacetate on the Grignard reagent:

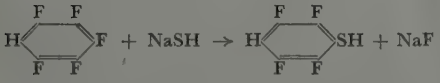
Dimethyl sulphate reacts on the Grignard reagent to yield pentafluorotoluene:



My colleagues have made a detailed study of the fluorothiophenols obtained from hexa- and pentafluorobenzenes by treatment with sodium sulphide in pyridine:



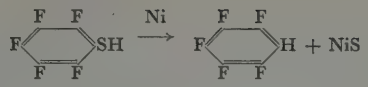
Pentafluorothiophenol



Tetrafluorothiophenol

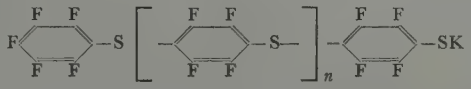
The following reactions of pentafluorothiophenol (C_6F_5SH, b.p. 143°) have been studied:

(*a*) Treatment with Raney nickel gave the pentafluorobenzene:

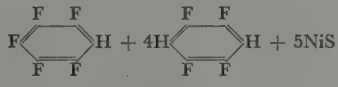


(*b*) Aqueous potassium hydroxide gave the highly crystalline potassium salt:

(*c*) The potassium salt on being heated gave a polymer (an amorphous solid)—a perfluoropolyphenylene thioether



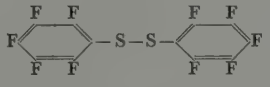
(*d*) The latter polymer desulphurizes with Raney nickel in butanol to give a 1:4 mixture of pentafluorobenzene (from end group) and 1,2,4,5-tetrafluorobenzene, suggesting a chain-length of about 5 units, *i.e.*



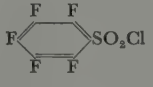
1,2,4,5-Tetrafluorobenzene

(*e*) The same polymer can be made directly from the C_6F_6 by using a deficiency of sodium sulphide.

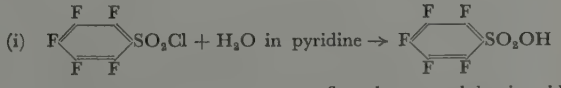
(*f*) When the thiophenol is dissolved in acetic acid and treated with 1 mole of bromine the disulphide is formed:



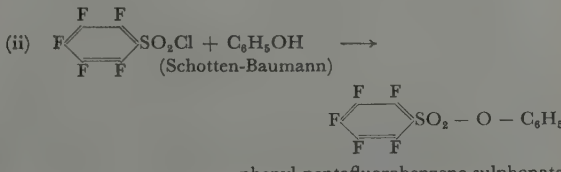
(*g*) The disulphide on treatment with chlorine in aqueous acetic acid gave the sulphonyl chloride:



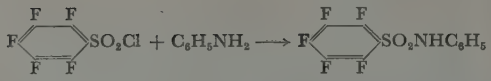
(*h*) Various reactions of this sulphonyl chloride have been carried out:



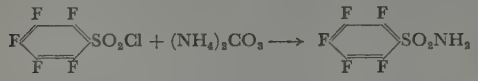
pentafluorobenzenesulphonic acid



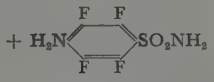
phenyl pentafluorobenzene sulphonate

(iii) 

pentafluorobenzenesulphanilide

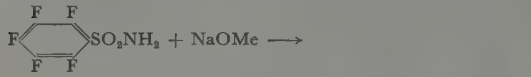
(iv) 

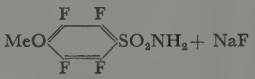
Pentafluorobenzenesulphonamide



The last reaction (iv) shows the lability of the *p*-fluorine (*cf.* corresponding compounds from tetrafluorothiophenol); further demonstrations of this were found, namely:

(i) Treatment of the pentafluorobenzenesulphonamide with sodium methoxide in methanol gave a compound believed to be the *p*-isomer of tetrafluoromethoxybenzenesulphonamide (positive orientation not yet made)





Other substitutions involve the use of pentafluorophenyl methyl sulphone, $C_6F_5SO_2CH_3$, which was prepared from the thiol by treatment with diazomethane to give the methyl ether:

$$C_6F_5SH + CH_2N_2 \xrightarrow{\text{in ether}} C_6F_5SCH_3 + N_2$$

pentafluorothioanisole

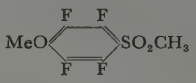
which was then oxidized with hydrogen peroxide in acetic acid:

$$C_6F_5SCH_3 + 2H_2O_2 \longrightarrow C_6F_5SO_2CH_3 + 2H_2O$$

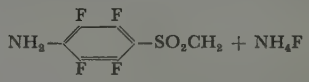
pentafluorophenyl methyl sulphone

Substitution effects on this are:

(i) Sodium methoxide in methanol:



(ii) Aqueous ammonia (s.g. 0·88):



Similar reactions were carried out on the tetrafluorothiol. The orientation of this was determined by desulphurization with Raney nickel, which gave exclusively 1,2,4,5-tetrafluorobenzene.

In the industrial field many new applications are steadily coming forward, the most striking being the refrigerants, aerosols and polytetrafluoroethylene. In a recent book on fluorocarbons published in the U.S.A. (*Fluorocarbons*, M. A. Rudner, New York: Reinhold Publishing Corporation, 1958) it was stated that sales of PTFE in all fields in 1956 reached $60,000,000 and sales amounting to $170,000,000 were forecast for 1959.

The author's thanks are due to his colleagues, Professor J. C. Tatlow, Dr J. Burdon and Dr W. I. Stephen.

SPRING LECTURE COURSE

DEVELOPMENTS IN ANALYTICAL CHEMISTRY

The Birmingham and Midlands Section of the Institute has arranged for its Spring Lecture Course, 1960, on 'Developments in Analytical Chemistry,' to take place in the Byng Kenrick Suite, College of Advanced Technology, Gosta Green, Birmingham, 4.

The programme is as follows:

Saturday, 5 March: 'Developments in Inorganic Analysis,' Professor R. Belcher; 'The Work of the S.A.C. Analytical Methods Committee,' Dr D. C. Garratt.

Saturday, 12 March: 'Newer Analytical Methods for the Smaller Laboratory,' Dr R. F. Milton; 'Some Observations on New Analytical Methods,' Dr J. Haslam.

Saturday, 19 March: 'Some Recent Developments in Mass Spectrometry and Nuclear Magnetic Resonance,' Dr J. D. Waldron; 'A Research School of Analytical Chemistry,' Professor C. L. Wilson.

Saturday, 26 March: A discussion on 'Training in Analytical Chemistry' to be opened by Professor R. Belcher (University Aspects), Mr H. Holness (Technical College Aspects) and Mr W. T. Elwell (Industrial Aspects); A visit to Professor Belcher's Research School of Analytical Chemistry in the Chemistry Department, University of Birmingham.

Registration forms and further particulars may be obtained from Dr M. Williams, Hon. Assistant Secretary (Birmingham and Midlands Section, R.I.C.), 24 Conchar Road, Sutton Coldfield, Warwickshire.

Book Reviews

CHYMIA: ANNUAL STUDIES IN THE HISTORY OF CHEMISTRY, VOLUME V. Editor-in-Chief, H. M. Leicester. Pp. 214. *Pennsylvania: University Press; London: Oxford University Press*, 1959. 40*s*. net.

Of the 14 papers which compose this Volume one is a biobibliography of Edgar Fahs Smith, sometime Professor of Chemistry and Provost of the University of Pennsylvania; four relate to protohistory and antiquity; eight are more or less closely connected with the 'Chemical Revolution'; and two have no special affinities.

In the biobibliography Herbert S. Klickstein describes how Smith, disclaiming the title of historian, nevertheless—or perhaps for this reason—brought to life the names in the textbooks and so played a major part in the creation of the field of history of chemistry in America. The extensive bibliography of the extant collection of his memoirs, reviews and notes, in print and in manuscript, should be a lasting source of background materials, especially of some of what he called the 'overshadowed' chemists and their books.

In two papers on refining of gold and on bronze in Mesopotamia (in the second of which he is assisted by E. J. Burke) Martin Levey has used both kinds of 'documents'—the primary literature chiefly for evidence of refining and alloying, the metal artefacts themselves in the case of bronze. The application of metallographical and chemical analysis to the latter can reveal the 'history' of the fabrication in relation to casting and heat-working.

Trevor Robinson's 'edited' translation of Theophrastos's *On Fire*, by what seems to be an oversight, contains no mention of what text was used. Having gone to so much pains to make this work available in English he would doubtless be among the first to admit that such documents can be very misleading unless the authenticity of the text can be guaranteed.

Priyadaranjan Rây's *Chemistry in Kautilya* is a scholarly extraction from a large Indian work on 'statecraft' in the broadest sense; the critical question of dating this document—ever present in Indian studies—is squarely faced.

Five of the eight papers relating roughly to the 'Chemical Revolution' will have to be unceremoniously lumped together:—Henry Guerlac, *Some French Antecedents of the Chemical Revolution*; Maurice Daumas and Denis Duveen, *Lavoisier's large-scale Decomposition and Synthesis of Water*; J. R. Partington, *Berthollet and the Antiphlogiston Theory*; Henry M. Leicester, *The Spread of the Theory of Lavoisier in Russia*; Sidney M. Edelstein, *The Chemical Revolution in America from the pages of the Medical Repository*. Guerlac's long dissertation contains a mass of interesting information, but 'antecedents' is so generously interpreted that one wonders whether, reorganized and in some places less condensed, it wouldn't make a very valuable book. The account of Lavoisier's large-scale quantitative work on water is a model of its kind; but I wish the commentators had told us why the time at which water began to percolate had to be measured to within 1 second! Having for many years used the chemistry of 'dephlogisticated marine acid air' as an example of the formal superiority of the *neo*-phlogiston theory over the 'oxygen' theory, I am particularly grateful to Partington for the provision of this much more extensive documentation of the French case than I have been able to use. The spread of the new ideas in America and among Russian chemists is dealt with by Edelstein and Leicester respectively. The former has provided what seems to be a final chronology of the 'Counter-Revolution' in America, but his strictures on Priestley's experimental competence seem rather ill-founded: few experimentalists are seen at their best after starting a new life at 65! The latter contains interesting views on the reasons for the slow spread of the new ideas in Russia.

Concerned with the 'fringe' of the 'Revolution' are Robert E. Schofield's *Josiah Wedgwood, Industrial Chemist* and Robert Siegfried on *The Chemical Philosophy of Humphry Davy*. The former is in some ways the most satisfying of all the articles—a definite problem is posited, limited in scope, and to me (little experienced in this field) a satisfying revaluation is achieved. My only criticism is that two problems—'being a scientist' and 'applying science to industry' are not clearly distinguished; also by erecting too stringent criteria for the former, Schofield at times comes near to being tedious. Something of the same sort applies to Siegfried: I suggest that his assumption that Davy did not achieve any success in 'significant theoretical work' comes from his taking Davy's own 'positivistic' utterances too seriously, and unduly restricting the idea of 'theory.' Nevertheless the article brings out very well a side of Davy's character insufficiently recognized—at least by me!

The two remaining articles are useful if unspectacular contributions to knowledge—Wyndham D. Miles on the Columbian Chemical Society, alleged to have published the first periodical of a chemical society (1813); and Mel Gorman and Charles Doehring on the *History of the Structure of Acetone*.

WILLIAM P. D. WIGHTMAN

CLASSIFICATION AND INDEXING IN SCIENCE. Second Edition. B. C. Vickery. Pp. xix + 235. *London: Butterworths Scientific Publications; New York: Academic Press Inc.*, 1959. 30*s*.

In February of this year I had the pleasure of reviewing the first edition of this work (*J.*, 89), and now in November of the same year a second edition is presented. It is good to know that the first edition has

been so widely read; I shall, however, confine my attention in this review to the differences between the two editions. In general, the character of the first edition is retained and the first three chapters and the appendixes remain virtually unchanged. Chapter IV (formerly chapter V) on 'Indexing' is considerably expanded and now gives a much better picture of the subject. In this chapter a special section has been devoted to the indexing of chemical substances; it is well done (in view of the compression into a few pages). It is, perhaps, a little too ingenuous to remark (p. 102) that 'the effect (of inverted indexing) is . . . that all Benzaldehyde derivatives are grouped together' without saying that this is quite untrue of the majority of group combinations, for example, his 3-acetamido-2-amino-5-methylbenzaldehyde will be found under 'Benzaldehyde' but cannot be traced as a derivative of aniline, phenylacetamide or toluene.

It would have been good to have discussed page 103 with the IUPAC Commission and so have avoided the errors in the ciphers (use of brackets instead of parentheses was abandoned some years ago) and by putting capital I's instead of 1's the author has turned Wiswesser's cipher into a tri-iodo compound!; further developments have led to the IUPAC cipher B6CQ(EQC$_2$)4N(C)$_2$2 for the compound in question in which the comma and period difficulty has been eliminated. On p. 104 I would prefer to write the molecular formula as As$_2$.2.221$_2$1$_8$—omitting the letters in the last decade of citations.

Chapter V on mechanical selection is excellent and the additional matter well presented and of importance; many of the valuable conclusions of the Washington ICSI conference of 1958 are included here.

Chapter VI has been completely rewritten and embodies many of the conclusions of the Washington Conference of 1958 and includes an account of the very interesting recent work of Luhn on the statistical approach to document content.

I have nothing but praise for this book; well written, well revised and expanded and well printed. It is a 'must' for any worker seriously interested in the field.

G. M. DYSON

AN INTRODUCTION TO CHEMICAL NOMENCLATURE. R. S. Cahn. Pp. viii + 96. *London*: *Butterworths Scientific Publications*, 1959. 10*s*. 6*d*.

The author does not claim to have written a complete textbook on his subject, for which he does not consider the time yet ripe. Instead he has set out in a remarkably clear and concise manner the principles of chemical nomenclature. Full account is taken of the latest developments, including the most recent IUPAC report on inorganic nomenclature. Useful features of the book are the comments throughout both on Chemical Society practice and on the major differences between systems of nomenclature adopted on the Continent, in the United States and in the United Kingdom. Sufficient examples are quoted to illustrate clearly the principles of modern nomenclature.

In the inorganic field, the result of the 1957 IUPAC report has been a move towards a much more systematic nomenclature. Chemists may be reluctant to accept disodium tetroxosulphate in place of sodium sulphate, but they will doubtless prefer trioxorhenic(v) acid for $HReO_3$ and tetroxorhenic(vi) acid for H_2ReO_4 to the chaotic nomenclature previously used in rhenium chemistry. Lithium tetrahydroaluminate for $Li(AlH_4)$ may surprise some, but Dr Cahn's pithy comment on the older name will give food for thought.

To those chemists whose interests are not in the field of organic chemistry the naming of organic compounds often appears to be systematic only round the edges and to lead to a maze of trivial or semi-trivial names nearer the centre. Dr Cahn devotes six chapters to organic nomenclature and succeeds both in providing some very helpful guiding rules and also in showing the formidable difficulties in the way of a universal system of nomenclature.

The book is, as one would expect from the author, well written and contains touches of humour which enliven what otherwise might be a dry, albeit significant, aspect of chemistry. So much information is packed into its 90-odd pages that the style is occasionally as telegraphic as a paper in the *Journal of the Chemical Society* after editorial revision. Thus it took the reviewer a minute or two to sort out the statement on p. 22 to the effect that 'Polyatomic cations formed by adding protons to monoatomic anions have the ending -onium: ammonium, phosphonium. . . .'

To sum up, all chemists can afford to purchase *An Introduction to Chemical Nomenclature*; they cannot afford to do otherwise.

J. E. SALMON

SANDWICH COURSES. P. F. R. Venables. Pp. 160. *London*: *Max Parrish*, 1959. 18*s*.

At a time when our attention is being focused on the changing pattern of technological education, Dr Venables's book, *Sandwich Courses for the Training of Technologists and Technicians*, provides a valuable review of what has so far been accomplished in this particular field.

Although the pattern of these courses is still in process of development, what has been done at Birmingham represents as advanced a pattern as it is possible to obtain, and Dr Venables has experienced many of the difficulties associated with a new type of course.

Detailed consideration is given to the necessity of providing an integrated structure, the experience gained in industry constituting an essential part of the training closely related to the theoretical studies in the college, in marked contrast to the alternative pattern established in university and other full-time courses, where any

connection between the industrial experience before or after the full-time academic course is largely coincidental. It is hoped that the introduction of these new courses will represent an additional contribution to the training of technologists and technicians, and will not be introduced at the expense of any existing alternative courses of study.

Dr Venables in the earlier chapters, and also Mr Ratcliffe in his contribution on industrial training, tend to suggest that the sandwich courses might be the only route for the training of technologists in the future, and those not so trained could only hope to be classified as technicians. The detrimental effect of the widespread acceptance of such an assumption, however, is mitigated in the review of the next decade, when due recognition is given to the value of many of the existing alternative routes to qualification.

The rapidity of change in this field is clearly indicated by the fact that certain problems relating to finances, the operation of the block grant system, and the higher award by the Hives Council have been resolved since the publication of the book; it will, however, form a useful reference for the many educationalists and industrialists who must be intimately concerned with the problems and development of sandwich courses if the expansion the Government is seeking for this type of course is to be achieved.

E. C. SMITH

CHEMICAL CONSTITUTION. Second edition. J. A. A. Ketelaar. Pp. viii + 448. *Amsterdam*: *Elsevier Publishing Company*; *London*: *D. Van Nostrand Company Ltd*, 1958. 47*s*. 6*d*.

The new edition of Professor Ketelaar's book on *Chemical Constitution* is very welcome. The book is about the theory of chemical bonding, but includes a full discussion of forces between molecules as well as the forces that hold individual molecules together. Most books on molecular structure and valency theory are lop-sided, in paying insufficient regard either to the mathematical basis of valency theory or to the bewildering diversity of chemical facts. This is not a fault of Professor Ketelaar's book, which is written by someone who not only understands wave mechanics but also is aware of the complexity of chemistry as an experimental subject. The second edition of the book contains some new sections of great value. These include a discussion of the absorption spectra of inorganic complexes in terms of the ligand field theory, the nature of the hydrogen bond, the chemical applications of quadrupole measurements, the chemistry of the transuranic elements and a discussion of semi-conductors.

There is only one small criticism which might be made, namely that the theoretical approach is insufficiently unified. It is not an easy matter to grasp the relationship between the descriptive resonance theory and the various forms of molecular orbital theory, and this problem of reconciliation may prove rather difficult for the reader. Nevertheless the book is a mine of useful and significant information and is to be strongly recommended to any student who wishes to acquaint himself with the modern electronic theory of chemistry.

H. C. LONGUET-HIGGINS

ELECTROLYTIC CONDUCTANCE. R. M. Fuoss and F. Accascina. Pp. ix + 279. *New York*: *Interscience Publishers, Inc.*; *London*: *Interscience Publishers Ltd*, 1959. 59*s*.

The preface tells the reader that a more accurate title for this book would be 'Development of the Theory of the Electrical Conductance of Dilute Solutions of Symmetrical Electrolytes.' The authors' stated object was to collect the results of papers on the theory of conductance and to produce 'a source book for part of a course on electrochemistry for first year graduate students.' Review chapters on electrostatics and vectors, hydrodynamics, statistical mechanics, and thermodynamics form an 80-page introduction to the book and these are very lucid, but their contents are readily available elsewhere, and they should perhaps have been excluded from the monograph. All subsequent chapters in the book are devoted to the derivation and discussion of an expression relating the equivalent conductivity Λ of a 1 : 1 electrolyte to the solute's concentration c:

$$\Lambda = \Lambda_0 - Sc^{1/2} + Ec\log c + Jc$$

(terms significant at higher concentrations, such as that in $c^{3/2}$, are omitted). Formulae deduced for S, E and J are based upon a model in which the ions are considered to be hard spheres surrounded by a continuum. The derivations are attractive and an able student should be able to follow the arguments easily. However, I am not sure if he would profit greatly by working through the book in detail, for I do not share the authors' confidence in the model (on p. 203 a slight discrepancy for KCl is considered to be additional support!). To my mind, the importance of past theoretical work on the conductivity of dilute solutions was its establishment of the *form* of the dependence of Λ on c; the actual values of Λ_0, S, E, J, etc. for particular models are less significant. I feel that the authors have insufficiently emphasized the complexity of interacting ions and solvent molecules, and their continual use of phrases such as 'ions in physical contact' might encourage a naïve reader to form a limited and inaccurate picture of reality. It is amazing that, after stating in the preface that the theory of the conductance of dilute electrolyte solutions 'now appears to be substantially complete,' the authors do not even mention Mayer's cluster theory (1950) relating in a precise way the thermodynamic properties of a solution to the potentials of average force between groups of one, two, . . . ions at infinite dilution. I shall be surprised if (as anticipated by the authors, p. 242) the theory of the future

succeeds in relating the behaviour of a dilute electrolyte solution to just two arbitrary constants, namely 'a distance which characterizes ion-ion contacts and another which characterizes ion-solvent contacts.' Also, is there *really* a fundamental difference between a neutral molecule and an ion-pair (p. 208)?

Those who need a thorough treatment of the problem of the conductivity of a model electrolyte solution should find this book very helpful, and I for one am glad to see the beautiful work of Debye, Hückel, Onsager, Fuoss and others made into a single story.

A. D. BUCKINGHAM

ELECTROLYTE SOLUTIONS. Second Edition. R. A. Robinson and R. H. Stokes. Pp. xv + 559. *London*: *Butterworths Scientific Publications*; *New York*: *Academic Press Ltd*, 1959. 65*s*.

When Robinson and Stokes's *Electrolyte Solutions* first appeared in 1955 it was welcomed by me as providing a most valuable account, at once authoritative and concise, of a difficult field. The second edition retains the virtues of the first and also brings the treatment up to date. The general arrangement of the work remains much the same, and indeed the chapter headings are practically unchanged, but each section appears to have been re-assessed and new work and references included. A very welcome feature of this edition, as of the first, is the emphasis placed on experimental methods, and good accounts are included of modern techniques of conductivity measurement, transport number determination, the study of diffusion and the various methods of obtaining activity coefficients.

Four years is a relatively short period in the life of a classical work of this kind, and while the new edition is useful in the fuller treatment that it gives to concentrated solutions of electrolytes and non-aqueous solutions, and the amplified numerical appendixes which it provides, it is doubtful whether many private readers will wish to spend 65*s*. on acquiring it if they already have the first edition. It would seem reasonable to suggest that future revision of what is undoubtedly to be regarded as a standard work should take place at rather longer time intervals.

A. HICKLING

THE PHYSICO-CHEMICAL CONSTANTS OF BINARY SYSTEMS IN CONCENTRATED SOLUTIONS. VOLUME II. TWO ORGANIC COMPOUNDS (AT LEAST ONE A HYDROXYL DERIVATIVE). J. Timmermans. Pp. xii + 1272. *New York*: *Interscience Publishers Inc.*; *London*: *Interscience Publishers Ltd*, 1959. 218*s*.

A notice of Volume I of this new compilation has already appeared (*J.*, 1959, 372) and what was said about that volume applies in the main to the second. Volume II completes the tabulation of data on organic binary mixtures. Users of the work must now await the appearance of the fourth and final volume, which, we are promised, will contain a full index and complete bibliographical references to the original sources of data. Till these are available the utility of this new reference work must be limited, since the only clues to sources are the authors' names and the years of publication.

It is evident on cursory examination that these 2,531 pages of the first two volumes of 'Timmermans' contain a vast store of extant information on the physico-chemical properties of organic binary mixtures. In fact, many of the measurements of these so-called constants are very old, and Timmermans himself (*vide* his Preface) is the first to throw doubt on their value. It is also true that a good deal of what Timmermans has assembled can be found elsewhere: for example, a comprehensive compilation of vapour–liquid equilibrium data has been made by Ju Chin Chu and compilations of azeotropes by Lecat and by Horsley. But Timmermans has cast his net much more widely and he includes such data on heterogeneous equilibria as critical constants, critical solution points, freezing points, data on phases such as densities, coefficients of expansion and compressibilities, viscosities, surface tensions and optical, electrical and thermal constants. The main value of Timmermans' method of presentation is that for a given mixture the state of completeness of knowledge can be quickly seen.

Some users of the book may, however, find it a defect that data on mixtures containing as one component a substance of particular importance (such as benzene, alcohol or phenol) are scattered. Others may regret that aqueous solutions of organic compounds nowhere find a place in this work, although Volume III, still to come, promises data on aqueous solutions of inorganic compounds. Aqueous solutions of many hydroxyl-containing compounds have an obvious importance, and one can only wonder at their exclusion.

The four volumes of this work are being produced by off-set printing from typescript, and one must accept that this is the only possible method. It is not of vital importance that the typewriter has so few characters that the symbols for physical quantities are unusual or not in accordance with agreed conventions (*e.g.* the use of *U* for specific heat). All that really matters is that the typewritten text should be consistent and accurate. Unfortunately, an examination of quite a small sample sufficed to show that the text is corrupted by mis-spellings, by confusions between power indices and figure subscripts, by inconsistencies and obscurities of expression and by insufficiency of explanation in some instances. On p. 72 there is a table of figures, referring to data by Sette (1950), under the general heading 'optical and electrical properties,' but no indication whatever to show that they refer to ultrasonic absorption. On p. 61 tables of figures due to Regnault (1862) are quite useless as they stand, since they refer to the boiling points and pressures of benzene–alcohol mixtures of unstated composition.

Nevertheless and in spite of its shortcomings this is an indispensable reference book, and wherever it is available it will save many literature searchers a good deal of time and trouble.

E. A. COULSON

STEROIDS. L. F. Fieser and M. Fieser. Pp. xvii + 945. *New York*: *Reinhold Publishing Corporation*; *London*: *Chapman & Hall Ltd*, 1959. 144*s*.

This book is the successor to the authors' *Natural Products Related to Phenanthrene* (Reinhold, 1949) and will undoubtedly take over its role as a standard work on steroids for both research worker and student. It is very well arranged and eminently readable.

As the title indicates, this new extension is devoted entirely to steroids; the tetracyclic triterpenes (trimethyl steroids) are included in this classification and occupy a whole chapter. Eight chapters of the previous work are expanded to twenty-two, each of which is clearly divided into a series of related topics, reasonably complete in themselves. This causes some repetition, but greatly clarifies the presentation. The most extensive reorganization involves material that included the early work on cholesterol and related problems, bile acids, alcohols and Vitamin D. These chapters in particular are frequently punctuated by points of personal, historical and experimental significance that provide additional interest throughout the book.

Material retained from the previous third edition has been almost completely rewritten and smoothly blended with the new material that has emerged in the rapid extension of the field since 1949. The co-operation of authors in supplying advance copies of papers in the press has made it possible to cover advances up to the early part of 1959. Recent theoretical developments, particularly conformational analysis, have been given due prominence, and a chapter on physical methods of characterization includes a description of rotatory dispersion, nuclear magnetic resonance, mass spectrometry and X-ray techniques, and an expanded version of the previous section on infra-red spectra. Other new chapters describe stereochemical correlations and conventions, displacements and rearrangements, the biosynthesis of cholesterol, and homo- and nor-steroids. Three chapters in the third edition, on sex hormones, adrenocortical hormones and steroid metabolism, are rearranged as four: oestrogens, androgens, progestogens and adrenocortical hormones, with the inclusion of a great deal of recent work which has been condensed and well arranged. Three large chapters are devoted to cardiac-active principles, sapogenins and steroidal alkaloids.

Subject and author indexes are adequate, and a glossary of conventions, abbreviations and principles of nomenclature, together with an orienting survey should be specially useful to students and others new to the field. A slightly altered system of steroid nomenclature and designation of configuration in side-chains, sapogenins and alkaloids is used and recommended by the authors as a desirable modernization.

There are one incorrect perpective diagram and a few misprints, but the omission of the 5-hydrogen atom in some diagrams is irritating, though rarely confusing.

Although this book does not follow the current trend of multiple authorship, its accuracy and reliability are ensured by the co-operation of 64 steroid chemists in reviewing the manuscript, or sections of it. There can be no stronger recommendation for this admirable book to those who are interested in steroids. It is unfortunate that the high price probably will cause it to appear more often in libraries than on private bookshelves.

D. N. JONES

ORGANIC CHEMISTRY. VOLUME II. STEREOCHEMISTRY AND THE CHEMISTRY OF NATURAL PRODUCTS. Second Edition. I. L. Finar. Pp. xi + 834. *London*: *Longmans, Green & Co. Ltd*, 1959. 45*s*.

As with Volume I, the merits of Volume II of 'Finar' have rapidly been recognized. First published in 1956, there was a new impression in 1958 and we now have the second edition revised and brought up to date. This revision has involved the addition of a hundred pages of new material, including sections on conformational analysis and on biosynthesis. Accounts are also given of nuclear magnetic resonance, correlation of configurations, isoflavones and vitamin B_{12}. There is more on dipole moments, molecular rotation, optical isomerism, steric effects, ascorbic acid, structure and synthesis of cholesterol, vitamin A_1, polypeptides, mechanism of enzyme action, flavones, streptomycin and patulin.

The excellence of the book, to which tribute was paid in the review of the first edition (*J.*, 1956, 723), has been enhanced by these additions. That is not to say that all those errors which are inevitable in the first edition of a volume of such wide range have been removed in the revision. On p. 679, a not-so-good synthesis of flavonols, which is hardly worth including, is stated to yield flavones. The section on isoflavones does not mention the synthetic methods which are normally of choice. Here one highlights the difficulty that presents itself to all authors of general textbooks for honours degrees. It is impossible to read all the literature relating to any one section, and accurately to separate and record the better synthetical methods available.

Sooner or later comprehensive textbooks for honours students will be the product of many expert minds. However, while works by one or two authors hold the field, it will be difficult to surpass 'Finar' for clarity of presentation and for wide coverage of the factual information academic fashion dictates as proper to the chemical neophyte.

T. S. WHEELER

ORGANIC SEQUESTERING AGENTS. S. Chaberek and A. E. Martell. Pp. xv + 616. *New York*: *John Wiley & Sons Inc.*; *London*: *Chapman & Hall, Ltd.* 1959. 200*s*.

This book has as its main title *Organic Sequestering Agents* and as subtitle 'A discussion of chemical behaviour and applications of metal chelate compounds in aqueous solutions.' Unfortunately these are far from synonymous. Lack of definition of subject has caused the authors to wander some distance outside the scope of their principal title without covering all relevant work.

A sequestering agent, surely, is a material added to a system to prevent the normal effects of metal ions (which may be detrimental to that system and its purpose and usefulness) from taking place. The exact structures of dyestuffs which are chelates and whose shades depend on the metals chelated, is a very interesting topic outside the principal title, but the ten pages devoted to it omit the relevant point that sequestering agents cannot be used in dyebaths if, as is normally the case, they interfere with this chelation. Similarly in biological systems the detailed treatment of materials like haemoglobin is very interesting but outside the main theme. On the other hand, the reader will search in vain for reference to the results of Bennett and Wise (*Trans. Faraday Soc.*, 1955, p. 695) or other treatment of complex equilibria involving, for example, the effects of two sequesterable metals, one sequestering agent and the competition of the hydroxyl ion on the system.

The method of ionization originally proposed by Schwarzenbach for EDTA has been applied by the authors in their 70-page Appendix 3 to all related amino carboxylic acids. Do the results of J. Chapman (*J. chem. Soc.*, 1955, p. 1766) justify this? On pages 12 and 14 the EDTA chelates of lead and calcium are represented diagrammatically as hexadentate. The grounds on which the authors justify their view would have been interesting. Appendix 4 gives a relationship between pH and pM for four amino carboxylic acids, including EDTA. No indication is given as to how these figures were calculated, but the insolubility of ferric hydroxide and the existence of sodium zincate seem to be ignored.

Certain metal deficiences, successfully treated by chelates in both agriculture and livestock management, have been considered as due to excessive presence of other metals. There is no mention in the ten pages devoted to agriculture of the possibility of one metal inducing deficiency of another. The authors may not agree with the conclusions referred to, but to ignore them is unwise.

The chapter on commercial applications is too academic in its approach—excusable in Professor Martell, perhaps, but Dr Chaberek is in industry. It seems to me that the readers would have been assisted if the information in the chapter on 'metal buffers' had been classified in other ways. Why have the printers omitted the chapter heading 'Commercial Applications of Chelating Agents' on the 12 pages devoted to table 7.26; and do the publishers really consider £10 an appropriate price for a book of 616 pages?

Much valuable information has been brought together in this volume. Omissions and the need for critical reading detract from its value.

R. L. SMITH

ELEMENTARY QUANTITATIVE ANALYSIS. H. F. Walton. Pp. ix + 342. *London*: *Sir Isaac Pitman and Sons, Ltd*, 1959. 45*s*. net.

Many American textbooks enjoy a high reputation in this country. Others, especially those of an introductory nature, prove, despite many attractive features, to be quite unadaptable to British systems of chemical education. As the author of this book is Professor of chemistry in the University of Colorado and the word elementary forms part of the title, one must first comment on the publisher's claim that the book will be of value to all students working for the General Certificate of Education at Advanced and Scholarship Level and the early stages of courses for B.Sc. General, Grad. Mem. R.I.C. and the like. I agree with the latter part of this claim. There would, however, have to be a considerable expansion of interest in and emphasis upon practical chemistry in our schools (and the examining bodies) before the book would be suitable for students preparing for 'A' and 'S' levels in the G.C.E. This must be taken to be as much a criticism of the G.C.E. as of the publisher's claim. The term 'elementary' is justified in so far as the book covers in considerable detail the theory and practice of the classical procedures of inorganic analytical chemistry. The major part of the book is devoted to the more common gravimetric and volumetric determinations but there are shorter chapters on ion exchange, electrolytic and photometric methods of analysis.

A distinctive feature of the book is the way in which the theory and technique of a procedure have been completely integrated instead of being relegated to separate sections, as is often the case. For example, the description and explanation of methods used for the gravimetric determination of chlorine occupies seven pages of text, excluding illustrations.

The author has, in addition, either resisted or not been subject to the temptation to write a book which combines the functions of student's textbook and chemist's reference book, since the number of procedures described, though representative, is strictly limited.

A praiseworthy effort has been made to help the student to do his own analytical thinking. Thus, the procedures described do not conclude with formulae in which the students' weighings and titres have to be substituted. Even gravimetric factors are deliberately omitted in order to discourage undue reliance on them as a substitute for chemical arithmetic. Each chapter concludes with a number of problems and exercises

which have been thoughtfully compiled and the working of which would be of great value to the student.

In the main this is an attractive book but it is a pity that the price will not encourage the average student to purchase it. H. R. JONES

SULPHUR IN PROTEINS. Proceedings of a Symposium at Falmouth, Mass., 1958. Edited by R. Benesch *et al.* Pp. xi + 469. *New York*: *Academic Press Inc.*; *London*: *Academic Books Ltd*, 1959. $14 (£5).

As Edsall remarks in his admirable summing-up, the title of this book is misleading, since the Symposium was devoted almost entirely to the cystinyl and cysteinyl residues of proteins and not to methionine. The vast amount of work reported testifies to the great importance of these particular residues in the make-up of a protein. It reflects too the debt we owe to the pioneers such as Hopkins, Mirsky, Anson and Rapkine, though, except for the last, little mention is made of them. One must admit that the sulphydryl and disulphide groups in proteins have invited attention because they can be selectively modified and the effects of modification carefully studied. Few of the many other side-chains are quite so amenable, but from less direct evidence we do know, from one or two instances, that they too may contribute fundamentally to the vital function of a protein.

The book is divided into sections dealing with specific groups of proteins: keratins, serum proteins, metal proteins, enzymes, muscle proteins and viruses. The last section, of great interest to the biologist, deals more generally with the role of sulphur in mitosis. This division is one of convenience, for the character of the investigations is not at all typical of the section.

The biochemist's interest in –SH and –S–S– falls into several well-defined categories, all authoritatively represented here: (1) the quantitative determination of cystine/cysteine residues; (2) their differing reactivity either within a single protein or as a comparison between one protein and another; and (3) the effect of modification on properties and function. The latter aspect is of overwhelming importance and the most difficult to interpret. It is easy to understand that the splitting of –S–S– bonds which form inter- and intra-chain bridges will so modify configuration that biological activity is lost. It is more difficult, however, to decide whether the blocking of an –SH group affects activity because it forms part of an active site, or less directly because some local change in tertiary structure is brought about. Whatever the answer, it must be recognized that –SH groups are essential to the action of many enzymes, to the functioning of both myosin and actin in the contraction cycle, to the interaction of haem groups in haemoglobin, and to the role of ferritin as an iron donor. All these and many other aspects are fully discussed in a book which should be of the greatest value to protein chemists and to many other brands of biochemists. An excellent feature is the extensive verbatim discussion at the end of each chapter, where the untutored reader will find criticism that is frank and often illuminating. K. BAILEY

INTERNATIONAL CONFERENCE ON CO-ORDINATION CHEMISTRY. Special Publication No. 13. Pp. 204. *London*: *The Chemical Society*, 1959. 42*s*.

This volume can be strongly recommended to all chemists interested in co-ordination chemistry in its widest sense. It contains the record of the Conference lectures and abstracts of contributed papers delivered at the International Conference on Co-ordination Chemistry which was held in London on 6-11 April, 1959, in conjunction with the Anniversary Meetings of the Chemical Society. These conferences are held at two-yearly intervals, and the rapidly increasing scope of co-ordination chemistry is indicated clearly by the fact that altogether 141 papers were read and discussed. To print the full text of all the papers would have involved the production of a large volume, at a price which would inevitably put it beyond the reach of many chemists interested in possessing it. The Chemical Society, therefore, made the courageous decision to include, in the Special Publication, the full text of the seven Conference lectures, but only abstracts of the contributed papers. Nevertheless, in almost all cases these abstracts are given in a way which makes the author's contribution to co-ordination chemistry quite clear. The result is a relatively small book which will acquaint the reader with recent trends in all the most important branches of the chemistry of complexes.

The Conference lectures occupy 112 of the total 204 pages. Their titles are: 'New aspects of some organometallic complex compounds' (Karl Ziegler); 'The stability of metal complexes' (H. M. N. H. Irving); 'Metal carbonyls and related compounds as catalytic intermediates in organic syntheses' (H. W. Sternberg and I. Wender); 'Mechanism of complex ion reactions: recent advances' (H. Taube); 'Co-ordination compounds of unsaturated hydrocarbons with metals' (E. O. Fischer); 'Metal-ligand bonds' (L. E. Orgel) and 'Complex acetylides of transition metals' (R. Nast).

The contributed papers are mainly concerned with recent developments in four fields: (*a*) the co-ordination chemistry of carbon and the use of carbonyls, organometallics, hydrides and so on as reagents and catalysts in organic chemistry (special emphasis was placed on this topic); (*b*) the theory and physical chemistry of co-ordination compounds, including stability constants; (*c*) the complex chemistry of the less common ligand atoms (*e.g.* P, As, Sb, S, Se, Te, F); and (*d*) metal complexes of topical or industrial interest (this section deals only with new compounds or new applications).

The volume is well printed, produced and indexed. C. C. ADDISON

BRIEF COURSE IN ORGANIC CHEMISTRY. Second Edition. L. C. Behr, R. C. Fuson and H. R. Snyder. Pp. viii + 289. *New York*: *John Wiley & Sons Inc.*; *London*: *Chapman & Hall Ltd*, 1959. 46*s*.

This is a book about which teachers cannot be neutral. They will either approve or disapprove—and strongly. In considering the book it is important to bear in mind its purpose:—'for use in short courses in organic chemistry for students of agriculture and home economics and pre-professional students in medicine, dentistry, medical technology, pharmacy, nursing and veterinary medicine.' The second edition has been revised in the light of experience in the use of the first edition, and 'contains references to many substances of practical value not found in other books, such as vitamins, hormones, other natural products, medicinals, agricultural chemicals, and other substances of biological interest. New chapters on homologous series, naturally occurring esters and sulphur compounds have been added.' Technically the book is perfect. I would quarrel with very few statements of fact, and would congratulate authors and publishers on the layout and freedom from typographical errors. Unfortunately, the price, as with all American books, is high.

I dislike the book for several reasons. First, so many interesting facts, from the use of ethylene in the preservation of citrus fruits to pictures of monkeys fed on and deprived of vitamins, are included that the basic outline of organic chemistry becomes submerged. Since it is extremely important for elementary students to grasp this, a textbook for them must be somewhat bereft of detail, and certainly must avoid irrelevancies. Secondly, although this book is intended for special readers, I doubt if the inclusion of vitamins, hormones and other natural products is of any real use. Neither are references to ferbam, ziram and malathion (p. 233), for instance, of any value. Thirdly, mechanisms! The treatment is to ignore them in the text and deal with them only in a special final chapter. Although this avoids the common fault of over-indulgence, often to the point of obscurity, it is unwise to pass over such reactions as addition to C=C or C=O without a brief mention of the mechanism. Fourthly, aliphatic and aromatic chemistry are developed side by side, and 'the similarities among aliphatic, aromatic and heterocyclic compounds, rather than their differences, are stressed.' Although this teaching approach seems so logical as to be highly desirable, even the best teachers have been known to try it with disastrous results and to revert to the usual method of following aliphatic chemistry with aromatic. Even were students capable of digesting both branches simultaneously, I think that to proceed within three pages from the first mention of the preparation of aldehydes and ketones to that of methyl 2-thienyl ketone is too much.

As I said earlier, it is impossible to be neutral about this book. If one grants the premises of parallel development of aliphatic, aromatic and heterocyclic chemistry, of generous inclusion of industrial and biological details and of brief reference to important natural products—vitamins, steroids, plant pigments—in an elementary book, then Behr, Fuson and Snyder is excellent. If these premises are not granted, the book, as an elementary text, must be condemned.

P. A. ONGLEY

PUBLICATIONS RECEIVED

PHARMACEUTICAL LEGISLATION IN GREAT BRITAIN. Allan Duckworth. Pp. 23. (Paper presented at the International Congress on the Problems of European Pharmaceutical Legislation held under the auspices of the Italian Society of Pharmaceutical Science, Rome, 1959.) *London: Association of British Pharmaceutical Industry.*

DOMINION LABORATORY PAPERS 1865–1958. Rona D. Clark. D.L. Report No. 2014. Pp. 54. *New Zealand*: *Dominion Laboratory D.S.I.R.*, 1959.

SCIENCE ABSTRACTS OF CHINA. CHEMISTRY AND CHEMICAL TECHNOLOGY, 1–77. Pp. 29. *Peking*: *Institute of Scientific Information*, 1958.

INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY. Information Bulletin No. 9. Pp. 55. *London*: *Butterworths Scientific Publications*, 1959.

NOTES FOR AUTHORS. Pp. 36. *London*: *The Institute of Physics*, 1959. 3*s*. 6*d*.

FOURTH ANNUAL REPORT OF THE WATER RESEARCH ASSOCIATION. Pp. 31. 18 *Linkfield Lane, Redhill, Surrey*, 1959.

JOURNAL OF THE POLAROGRAPHIC SOCIETY. No. 2, 1959. Pp. 25–44. 76 *Orpin Road, Merstham, Surrey*. 12*s*. 6*d*.

CITY OF MANCHESTER RIVERS DEPARTMENT: REPORT FOR THE YEAR ENDED 31ST MARCH, 1959. Pp. 48. *Rivers Department, Town Hall, Manchester*, 1959.

STUDIES IN CRYSTAL PHYSICS. M. A. Jaswon. Pp. 42. *London*: *Butterworths Scientific Publications*, 1959. 10*s*. 6*d*.

WIGGIN NICKEL ALLOYS. NO. 54. Pp. 30. *Henry Wiggin and Company Limited, Wiggin Street, Birmingham* 16, 1959. Free on request.

WELDING NIMONIC HEAT-RESISTING ALLOYS FOR GAS-TURBINE ASSEMBLIES. Pp. 19. *Henry Wiggin & Company Ltd, Wiggin Street, Birmingham* 16, 1959. Free on request.

PRESERVATION OF DOCUMENTS BY LAMINATION. W. K. Wilson and B. W. Forshee. Pp. iii + 20. *Washington*: *Nat. Bureau of Standards*, 1959. 20 *cents*.

X-RAY ATTENUATION COEFFICIENTS FROM 10KEV TO 100MEV. R. T. McGinnies. Pp. 10. *Washington*: *Nat. Bureau of Standards*, 1959. 15 *cents*.

Institute Affairs

GRADUATE MEMBERSHIP EXAMINATION
PART II
MARCH-APRIL, 1960

The theoretical section of the examination—Part II(a)—will be held in London and Newcastle upon Tyne and, if required, in other centres on **Monday and Tuesday, 28 and 29 March, 1960.**

Practical exercises will be carried out in London and in Newcastle upon Tyne on **Wednesday to Saturday, 30 March to 2 April,** inclusive, and in London on **Tuesday to Friday, 5 to 8 April,** and **Monday to Thursday, 11 to 14 April,** inclusive.

Candidates will be asked to state their preference as to the centre for their theoretical papers and the period and centre for their practical exercises, but it must be clearly understood that no guarantee can be given that their wishes will be met.

The last date for the receipt of Entry Forms is Monday, 15 February. No Entry will be accepted if received after that date.

NOMINATIONS FOR DISTRICT MEMBERS OF THE COUNCIL

The following nominations were received by the closing date, 28 November.

All these candidates are deemed to have been elected with effect from the date of the Annual General Meeting, 1960. Names given in italics are those of newly elected members, the others having been re-elected.

England

I Walter Wilson, B.SC., PH.D., D.SC., A.R.C.S., D.I.C.
II Frederick Denison Maurice Hocking, M.SC., M.B., B.S., L.R.C.P., M.R.C.S., A.C.G.F.C., M.I.BIOL.
III Leonard Powell Priestley, B.SC., DIP.ED.
IV *Reginald Elliott*, B.SC., PH.D., F.T.I., F.S.D.C.
V Percy Noel Williams, M.SC.
VI *Frederick Cecil Hymas*, M.SC.
Samuel Aaron Miller, M.A., B.SC., PH.D.
VII Sidney John Fletcher, B.SC., PH.D., D.L.C.
VIII Carl Christian Skou, M.SC.
IX Leonard Balmforth, B.SC.
X Albert Norman Edmondson, F.P.I.
XI Richard Eric Parker, B.SC., PH.D.

Wales and the County of Monmouth

I Sylvester John Herbert Owen Chard, M.SC., DIP.ED.
II *William Rogie Angus*, M.A., PH.D., D.SC.

Scotland

I Mearns Bruce Watson, B.SC., PH.D.
II *Frank Bell*, PH.D., D.SC., F.R.S.E.
III *Patrick Dunbar Ritchie*, B.SC., PH.D., F.P.I., M.I.CHEM.E., F.R.S.E.

Northern Ireland

William Ford Kirkpatrick, A.H.-W.C., F.I.C.I.

Republic of Ireland

Denis Crowley, M.SC., F.I.C.I.

Future Annual Conferences of the Institute.—It has been agreed that future Annual General Meetings and related Annual Conferences of the Institute shall be held as follows:

Southampton	..	20-22 April, 1961
London ..	..	1962
Leicester ..	..	18-20 April, 1963

The Council has been pleased to accept the invitations of the Mid-Southern Counties Section and the East Midlands Section for the meetings in 1961 and 1963. The dates of the Conference in London in 1962 will be announced in due course. In the meantime, the Council has provisionally accepted invitations from the North Wales Section and the North Lancashire Section to hold Annual Conferences at centres within their areas in 1964 (Bangor) and 1965, respectively. (For details of the Joint Annual Meetings at Belfast in April, 1960, see page 1 and the enclosed leaflets.)

Joint Library Committee.—The Council has re-appointed the following as representatives of the Institute on the Joint Library Committee for the year beginning 1 January, 1960:—Mr A. L. Bacharach, Mr. H. W. Cremer, C.B.E., Dr J. H. Skellon, Mr E. J. Vaughan.

Change of Liaison Officer. Mr A. B. Angus, Senior Lecturer in Chemistry at the Sheffield College of Technology, has succeeded Mr J. Hiles as Liaison Officer. Mr Hiles is now the Principal of this college.

Lectures, Monographs and Reports, 1959.—The 1959 series was completed with the distribution of Nos 3, 4 and 5 earlier this month.

No. 3. *Some Chemical Aspects of Plant Disease Control*, by Professor R. L. Wain (4s. 6d.)

This is based on a lecture given to the London Section in October, 1958. Crop losses can be reduced by breeding plants resistant to disease and by chemical control of plant diseases. Professor Wain gives a survey of investigations that have been carried out mainly on fungicidal agents, both inorganic and organic, and concludes with an account of progress in systemic fungicides in relation to the natural disease

resistance of plants, mentioning the discovery of an antibiotic in the stem and root tissues of broad bean seedlings.

No. 4. *Chemical Mechanisms in the Induction of Cancer*, by Professor A. Haddow (4s.)

In his 4th P. F. Frankland Memorial Lecture, delivered at Birmingham in March 1959, Professor Alexander Haddow discusses early work on compounds with pronounced carcinogenic potency and then considers the shift over the last 15 years from the mere recording of carcinogenic agents to studies of the means by which they induce their unique biological responses.

No. 5. *Modern Explosives*, by Dr W. Taylor (6s.)

Written by the late Dr Wilfrid Taylor for this series, the monograph first discusses explosion and detonation, explosive characteristics and intrinsically explosive substances (arranged by classes) before giving an account of the evolution of commercial explosives. The physical phenomena of detonation are then considered, together with the physical action of explosives and the hydrodynamic theory of detonation. Final sections deal with reaction mechanisms, coal-mining explosives and special applications.

Lectures, Monographs and Reports, 1960.—In future, items in the L. M. & R. series will be distributed separately from the *Journal*. It is proposed to continue printing them in their present format and to distribute them in parcels containing 2 or 3 items, as convenient, at intervals of 4 to 6 months. Forthcoming distributions will be notified in the *Journal*.

Monographs for Teachers.—A new item in this series will be ready shortly, and orders can now be received. It is:

No. 3. *Principles of the Extraction of Metals*, by Dr D. J. G. Ives (6s.)

Approximately double the length of the first two monographs in this series, it contains four main sections—an introductory thermodynamic background, an account of the thermodynamics of pyrometallurgical processes, a discussion of the choice of extraction methods and a description of some typical processes. It concludes with a list of more than 30 significant sources and references.

This monograph, while being written for teachers and advanced students of chemistry, will also be of considerable interest to metallurgists.

R.I.C. Filmstrips.—A black-and-white filmstrip on 'Optical Isomerism,' by Mr E. H. Coulson, *Fellow*, will be ready shortly. This is the second in the R.I.C. series of filmstrips produced by Common Ground Ltd, and it will be available, complete with teaching notes, at 25s. The first item in the series, 'Ion Exchange Resins,' by Dr T. V. Arden and Dr J. E. Salmon, is in colour and may be obtained complete with teaching notes from the Educational Supply Association, 181 High Holborn, W.C.1, price 42s.

Journal, Volume 83.—Readers who bind their Journals are asked to note that the *Report of the Council* for the year ending 30 September, 1959, will be issued in March and should be bound at the beginning of Volume 83. It will be printed in the same style and format as the *Journal* for 1959. For details of the binding service offered by arrangement with W. Heffer & Sons Ltd, see *J.*, 1959, 709.

Chemical Society Library.—The Institute makes a very considerable payment towards the maintenance of the Chemical Society Library under the Joint Library Scheme. All members, corporate and non-corporate, have full borrowing rights and should address their requests and enquiries direct to the Librarian, The Chemical Society, Burlington House, Piccadilly, London, W.1. It will be of great assistance to the Librarian if full bibliographical details of the works required are given.

The Library Regulations were last printed in the *Journal* in June 1958, p. 440.

PERSONAL NOTES

New Year Honours

The Officers and Council extend their cordial congratulations to the following Fellows and Associates, whose names appeared in the New Year Honours List:

C.B.E. David Christie MARTIN, B.SC., PH.D.

O.B.E. Henry Oscar ASKEW, M.A., PH.D., D.I.C., F.N.Z.I.C., F.R.S.N.Z.
Reginald Thomas COLGATE, D.SC., F.C.G.I., D.I.C., M.I.CHEM.E.
Howard Braithwaite STENT, M.SC.TECH.

M.B.E. Joseph Crosland MELLOR, B.SC.

Honours and Awards

Dr R. T. Fowler, *Associate*, has been awarded the degree of doctor of science in engineering of the University of Sydney and has been appointed Professor of chemical engineering at the University of New South Wales.

Dr G. J. Mohanrao, *Associate*, has been recommended for the degree of Sc.D., Massachusetts Institute of Technology, for his thesis on 'Activated sludge metabolism of certain quaternary carbon compounds' and will receive his degree at a graduation ceremony in June, 1960. Now a research fellow on the staff of California Institute of Technology, he has been loaned to the Scripps Institution of Oceanography to study the behaviour of radioactive caesium in the Hyperion Sewage Treatment Plant in Los Angeles.

Societies and Institutions

Mr L. W. Blundell, *Fellow*, was elected Hon. Treasurer of the British Tar Confederation at their Annual General Meeting in November last.

Mr H. W. Hignett, *Fellow*, of Henry Wiggin & Co. Ltd, has been elected a Vice-President of the Institute of Metals.

Dr H. Hollings, O.B.E., *Fellow*, has been elected an honorary member of the Institution of Gas Engineers.

Mr W. R. Jewell, *Fellow*, has been re-elected chairman of the Council of the National Association of Testing Authorities, Australia.

Royal Society.—At the anniversary meeting on 30 November, 1959, Professor Sir Cyril Hinshelwood, *Fellow*, was re-elected President; Sir Patrick Linstead, C.B.E., *Fellow*, and Professor R. A. Morton, *Fellow*, were elected Members of Council.

Society for Analytical Chemistry.—The following *Fellows* have been elected Officers of the Society's Physical Methods Group: *Chairman*, Dr G. W. C. Milner; *Vice-Chairman*, Dr W. Cule Davies; *Hon. Secretary and Treasurer*, Dr T. L. Parkinson.

Educational

Dr C. W. Brown, *Associate*, has relinquished his position with Imperial Chemical Industries Ltd to take up a post as lecturer in chemistry at the Municipal College, Oldham.

Dr R. J. Cremlyn, *Associate*, has left Imperial Chemical Industries Ltd to take up an appointment as lecturer in organic chemistry at Brunel College of Technology.

Dr P. B. D. de la Mare, *Fellow*, Reader in chemistry at University College, London, has been appointed to the Chair of chemistry tenable at Bedford College from 1 October, 1960.

Professor K. G. Denbigh, *Fellow*, Professor of chemical technology, University of Edinburgh and Heriot-Watt College, has been appointed Professor of chemical engineering science at the Imperial College of Science and Technology in succession to Professor P. V. Danckwerts. He will take up his new post on 1 October, 1960.

Dr R. F. Robbins, *Associate*, has left Nottingham to take up an appointment as senior lecturer in organic chemistry at Hatfield Technical College.

Dr G. Stainsby, *Fellow*, has relinquished his post as principal research officer, British Gelatine and Glue Research Association, and taken up an appointment as lecturer in the department of leather industries, the University of Leeds.

Consultants

Mr A. Herzka, *Associate*, until recently with the Metal Box Company, is intending to establish an independent practice as a pressurized packaging (aerosols) consultant, which will be carried on under the style of Pressurized Packaging Consultants Ltd. For the time being all enquiries should be addressed to him at 54 Woodlands, London, N.W.11 (Tel.: MEAdway 2816).

Mr K. G. Kimber, *Associate*, has left the Pyrene Co. Ltd, Brentford, and entered into association with the practice of R. H. Harry Stanger, as analytical chemist and consultant.

Mr K. R. Krishnaswami, *Fellow*, formerly Professor of mineral chemistry at the Indian Institute of Science, Bangalore, has joined Essen & Co., analytical and consulting chemists, of Bangalore as technical director.

Public and Industrial

Mr J. E. Adamson, *Fellow*, has taken up an appointment as research chemist with Polycell Products Ltd of London.

Mr L. F. Byrne, *Fellow*, has relinquished his post with Hardman & Holden Ltd to take up an appointment as head of research and development, Victor Wolf Ltd, Manchester.

Mr Alfred J. Coulthard, *Fellow*, head of H.M. Prison Service, Pathological Department, has been awarded the grading of principal biochemist (M.O.H.).

Professor E. G. Cox, F.R.S., Fellow, Professor of inorganic and structural chemistry, University of Leeds, will succeed Sir William Slater (*q.v.*) as secretary of the Agricultural Research Council on 1 July.

Dr P. W. Cunliffe, *Fellow*, of the British Cotton and Wool Dyers' Association Ltd, has been elected to the General Board of Directors.

Dr M. E. Darlington, *Graduate Member*, has been appointed as a section head in the development department of Midland Silicones Ltd, Barry, Glamorgan.

Mr J. B. Davies, *Associate*, has relinquished his post with A. Boake, Roberts & Co. Ltd and taken up an appointment as general manager of the Ellesmere Port works of the Flintkote Co. Ltd.

Dr R. R. A. Dils, *Associate*, has left Birmingham to take up a post with the Experimental Radiopathology Research Unit, Hammersmith Hospital.

Mr A. H. P. Doran, *Associate*, has been appointed assistant chief chemist of Scottish Brewers Limited, Edinburgh.

Mr Amos Gill, *Associate*, has retired from the post of industrial sales manager, Thomas Hedley & Co. Ltd, and has joined the Board of directors of Provincial Laundries Ltd, Newcastle upon Tyne.

Mr K. M. Godfrey, *Associate*, has left the Forestal Land, Timber & Railways Co. Ltd to take up an appointment as chief chemist to Golden Limited, the U.K. associates of L'Oreal of Paris.

Mr A. Gordon, *Associate*, has been appointed senior research chemist, Pyrene Co. Ltd, Brentford.

Dr Colin Haley, *Associate*, has relinquished his position at the Esso Research Centre, Abingdon, on his appoint-

ment to the European Chemicals Sales Service Group of Esso Research Ltd in London.

Dr D. S. Hoare, *Associate*, took up an appointment as senior scientific officer with the Agricultural Research Council in Sheffield on 1 October, 1959.

Dr E. M. Hunt, *Fellow*, general manager of Styrene Products Ltd, has resigned to join the Board of Utilex Ltd.

Dr K. F. Jennings, *Associate*, has relinquished his post with the Sterling–Winthrop Research Institute, Rensselaer, New York, to take up a position with the Distillers Company, Chemical Division, in London.

Dr W. A. Johnson, *Fellow*, has been appointed a director of Pure Chemicals Ltd.

Dr L. A. Jordan, C.B.E., *Fellow*, is a member of the commission set up by the Pakistan Government to examine the organization of scientific and technical institutions in Pakistan and to make recommendations for their development and co-ordination.

Mr K. McCarthy, *Associate*, left Truman, Hanbury & Buxton Ltd in October, 1959, and has joined the brewing laboratories and technical advisory staff of J. M. Collett & Co. Ltd.

Mr T. F. McCombie, *Associate*, of the British Drug Houses Ltd, organic chemicals department, has been appointed manager.

Mr K. P. Moore, *Associate*, of Imperial Chemical Industries Ltd (Billingham Division) has been appointed deputy products works manager at Prudhoe works.

Mr B. M. Oliver, *Associate*, of Farmer Hill Pty Ltd, Sydney, has been appointed to the Board.

Mr S. J. Sheppard, *Associate*, has been appointed assistant works manager, Plastics works, Imperial Chemical Industries Ltd (Billingham Division).

Dr J. K. Skelly, *Associate*, has left the College of Technology, Belfast, to take up an appointment with Ciba Clayton Ltd, Manchester.

Dr E. S. Stern, *Fellow*, has relinquished his post with J. F. Macfarlan & Co. Ltd to take up an appointment as research manager with Whiffen & Sons Ltd, Loughborough.

Mr W. H. Thomas, *Fellow*, has retired from the British Petroleum Company and is now employed as technical adviser to the Ministry of Power on all matters connected with the refining and quality of petroleum products.

Mr R. M. Ware, *Associate*, has relinquished his post with Impregnated Diamond Products Ltd and taken up an appointment as senior research chemist with the Plessey Company Limited, Towcester.

Mr J. M. Wilson, *Fellow*, has left the Standard Telecommunication Laboratories Ltd to take up an appointment as works manager at the Rectifier Division, Component Group, Standard Telephones & Cables Ltd, Harlow.

Sir Walter Worboys, *Fellow*, retires as chairman of the Council of Industrial Design on 31 January. He has held the appointment for seven years. Sir Walter has been elected a director of Mercantile Credit Co.

Committee on Natural Resources in Scotland.—The following *Fellows* are members of the Committee set up (*see* p. 42) by the Scottish Council (Development and Industry): Dr F. N. Woodward, C.B.E. (General Procedure); Dr A. B. Stewart (Land); and Dr B. Raistrick (Development).

National Lending Library.—Dr R. E. Fairbairn, *Fellow*, and Professor Geoffrey Gee, F.R.S., *Fellow*, are among the members of the consultative committee set up to advise the D.S.I.R. on the services of the National Lending Library for Science and Technology.

Retirements

Mr H. Kerr, *Fellow*, has retired as director of Woodall–Duckham Construction Company Ltd.

Sir William Slater, K.B.E., F.R.S., *Fellow*, will retire as secretary of the Agricultural Research Council in the summer. Sir William was a member of the Council of the Institute from 1953 to 1956.

Mr L. B. Tansley, M.C., *Fellow*, has retired as director of the Manchester Chamber of Commerce Testing House and Laboratory. Mr Tansley is chairman of the surgical dressings sub-committee of the Pharmaceutical Society.

Mr P. N. Williams, *Fellow*, has retired from Unilever Limited after 40 years' service. He was manager of the margarine and edible oils division in the research department at Port Sunlight.

Mr R. L. Wilson, *Associate*, has retired as manager of the refinery and distribution department of the Kuwait Oil Co. Ltd.

Mr Robert Wood, *Fellow*, has retired as chairman and managing director of Moler Products Ltd.

Sale and Purchase of Equipment and Apparatus.—The Publications Committee is of the opinion that the *Journal* can perform a very useful service to readers by acting as a clearing house for apparatus and equipment of all kinds. Frequently laboratories modify their programmes of work, and equipment, once essential, may become redundant. On the other hand the work may become more refined or extended in scope, and equipment that was once satisfactory may no longer be thought adequate. In such cases it would be useful to have a medium whereby the availability of such equipment and apparatus, often of high initial cost, could be notified widely. With its circulation approaching 19,000, and reaching every kind of chemical laboratory, the *Journal* is capable of becoming that medium. For these reasons the Committee has authorized the introduction in this issue of a 'For Sale and Wanted' column, in which also advertisements of specialized services for chemists will be accepted. The normal rate of 4s. per line will apply.

Section Activities

Birmingham and Midlands

Chemical Problems of Nuclear Reactors. On 29 October, a visit was made to Quickfit & Quartz, Ltd, at Stone, and in the evening Dr R. Spence, C.B., F.R.S., lectured at the North Staffordshire Technical College at Stoke on 'Chemical Problems of Some Nuclear Reactors.'

Dr Spence said that apart from the major chemical problems of atomic energy, such as the production of uranium, graphite, heavy water and the processing of spent fuel elements, a large number of less spectacular but nevertheless important problems have arisen. Principal among these is the incidence of unexpected chemical reactions between fuel elements, canning materials, coolants and structural materials.

In this country most progress has been made with the gas-cooled, graphite-moderated, natural uranium reactor, and the foremost problem here is to raise the operating temperature so that a more efficient conversion of heat to mechanical power is possible. This is limited by the reaction between carbon dioxide and graphite to a maximum of 650°C.

In North America development has been in the direction of pressurized-water reactors or boiling-water reactors, and here corrosion problems between irradiated water and structural materials have caused some difficulty. Another problem is the gradual formation by neutron irradiation of long-lived radio nuclides, which may be removed by the coolant and transported outside the biological shielding.

Many of these problems are not apparent until a reactor has been in operation for some considerable time, but the enormous capital cost of power reactors makes it essential that once constructed and put into operation they will last for many years.

The vote of thanks was proposed by Dr E. R. Patrick, Principal of the College.

Castable Refractories. Dr T. D. Robson gave a lecture on 6 November at the Wolverhampton and Staffordshire College of Technology on 'The Properties, Uses and Development of Castable Refractories.' The meeting was held jointly with the Wolverhampton Society of Applied Science, with Dr J. E. Gregory in the Chair.

Dr Robson said that it is difficult to think of any manufactured article which does not require refractories at some stage in its production. Castable refractories represent only a small part of the refractory field, but they are of growing importance and their use is already extensive.

Refractory castables or refractory concretes consist of mixes of crushed, graded refractory aggregates and high-alumina cement. When mixed with water and consolidated into moulds or formwork (as with ordinary concrete mixes), strength is rapidly developed, and the concrete is ready for refractory service within 24 hours of placing. No pre-firing is normally required. A wide range of dense refractory aggregates or light-weight refractory aggregates can be used, thus producing concretes with very varied density, strength, abrasion resistance, thermal conductivity, resistance to slags, and so on. However, the most commonly used aggregate is crushed firebrick (alumino-silicate). The ordinary grey-black high-alumina cement can also be substituted by the newer type of white high-alumina cement of much higher refractoriness, since it is purer and contains a higher proportion of alumina.

When refractory concrete is first heated up to the service temperature, the hydraulic bond is dehydrated, partially or completely, at temperatures between 200°C and 1000°C, and the strength is therefore reduced. At higher temperatures, thermal reaction between the cement and the aggregate may provide 'ceramic bond,' with consequent increase in strength. The minimum strength at intermediate temperatures is usually more than adequate for refractory applications, but an increase in such strength and also in the abrasion resistance can be obtained, where required, by increasing the proportion of cement in the original concrete.

This removal of combined water also causes a slight shrinkage during the first firing. It so happens that this shrinkage is almost equal in magnitude to the thermal expansion of the concrete materials and consequently there is little or no difference between the cold volume, as cast, and the volume at the operating temperature. Therefore, there is rarely any need to provide expansion joints in castable refractory construction. Butt joints, to provide for slight contraction on cooling down, are all that may normally be required.

One notable characteristic of refractory concrete is the very high thermal shock resistance which leads to the use of castable mixes for floors subject to radiant heat or to contact with molten slag and hot metals. Burner blocks and furnace doors made with refractory concrete usually give an extended life, either because of this property or additionally because of the monolithic construction.

Castable refractories have now graduated from the early applications as patches or special shapes to complete furnaces and kilns; the transition can be illustrated by examples from most industries, in particular those concerned with iron and steel, brick and ceramics, chemicals, petroleum, steam raising and non-ferrous metals. More recently, refractory concretes have been used for the construction of jet-engine or gas-turbine silencing cells, for rocket deflector pads or blast tunnels, and for operational pads used by vertical-take-off aircraft.

The vote of thanks was proposed by Mr M. E. D. Windridge.

Lectures at Keele and Birmingham. On 3 December, a lecture was given by Professor H. D. Springall at the University College of North Staffordshire on 'Structure of the Nucleic Acids.'

Dr F. W. Peaker lectured at Birmingham on 10 December on 'Some Applications of Light Scattering Methods in Chemical Research.' Mr G. E. K. Pritchett took the Chair at both meetings, and the votes of thanks were proposed by Drs F. H. Patrick and L. H. Vaughan, respectively.

BRISTOL AND DISTRICT

Dust and Diseases of the Lung. After two successful summer visits, one to the Esso Refinery, Fawley, and the other to the Avalon Leather Board Co. Ltd, Street, the winter session began on 15 October with a meeting at the British Cellophane Factory, Bridgwater. Dr P. F. Holt, of the University of Reading, gave a lecture on 'Dusts.' After the lecture, an abstract of which will be published shortly, there was a lengthy discussion. The fact that cases of aluminium poisoning had occurred was of special interest. Dr Holt pointed out that asbestosis, due to the lagging of pipes, was more likely to occur as a result of stripping dried asbestos than applying wet asbestos fibre. The question of preventive measures, once the problem had been appreciated, was relatively simple but the introduction of remedial steps in cases of some standing was not so straightforward.

Dinner and Dance. The second Annual Dinner Dance was held in Bristol on 29 October. Dr N. Booth (representing the President) and Mrs Booth, and Dr F. D. M. Hocking (District Member of Council) and Mrs Hocking were present. Menu cards bearing the arms of the Institute attracted much attention and appreciative comment.

Extraordinary General Meeting. This meeting, held on 12 November, was called to discuss recommendations to Council for the amendment of the Section Rules to permit the holding of the Annual General Meeting in November instead of in March, so that accounts, in particular, could be presented and discussed at a date nearer to the end of the financial year—30 September. A resolution of the Committee to this effect was approved unanimously, as was a second resolution recommending that the present officers and committee should continue to serve until the next Annual General Meeting in November, 1960.

A further recommendation of the Committee was that Council be asked to approve the division of the office of Hon. Secretary/Treasurer into the separate offices of Hon. Secretary and Hon. Treasurer. This was approved, and Dr E. J. Skerrett was provisionally elected Hon. Treasurer.

The officers for the ensuing year are, therefore, as follows: Chairman, Dr D. Woodcock; Hon. Secretary, Dr R. W. Bolland; Hon. Treasurer, Dr E. J. Skerrett; Members of Committee: Drs L. Hough, R. A. Parsons and R. B. Williams and Messrs F. W. Hares, C. Harris, B. W. E. Minifie, E. Minshall, G. H. Moore, R. V. Richmond and J. H. Weber.

After the formal business, Mr F. Morton of the Bristol Mental Health Department presented a film entitled 'Marlborough House,' which dealt with the training of the mentally retarded at this centre. The film aroused considerable interest in this work. It was one of the 10 best amateur films of the year. A second film, entitled 'El Dorado,' dealing with the development of British Guiana, was also shown.

CARDIFF AND DISTRICT

Hydrocarbon Polymers. The new session began on 7 October with a joint visit, together with members of the Society of Chemical Industry, Plastics Group, to the modern plant of British Nylon Spinners at Mamhilad. In the evening, at the King's Head Hotel, Newport, Professor C. E. H. Bawn, C.B.E., F.R.S., of the University of Liverpool, gave a lecture on 'Hydrocarbon Polymers.' Professor Bawn dealt in great detail with the synthesis and stereo-configuration of selected polymers and traced the relationship between properties and structure, illustrating this with slides and blackboard drawings.

After a very full discussion, the Chairman, Mr P. J. C. Haywood, called upon Professor A. G. Evans (University College, Cardiff) to propose the vote of thanks.

Chemistry in Building Research. On 23 October, at University College, Cardiff, Dr M. H. Roberts, of the Building Research Station, Watford, spoke on 'Chemistry in Building Research.'

In reviewing the various applications of chemistry in building research, the lecturer cited examples to show the importance of chemical studies in the correct selection and use of materials for constructional purposes. He gave an account of fundamental studies of the hydration of Portland Cement, aimed at obtaining a fuller understanding of the mechanism of the hardening and setting of cement, and the aqueous equilibria set up in the system lime–silica–alumina–ferric oxide with alkalis and sulphur trioxide. Dr Roberts outlined the techniques used in phase-equilibria studies, laying particular stress on the prevention of contamination by atmospheric carbon dioxide and by the careful drying of the solid hydrated phases under controlled conditions.

The investigations on the system lime–alumina–water, and the quaternary system containing calcium sulphate and calcium chloride, were described with special reference to the metastable forms of tetra- and di-calcium aluminate. The occurrence of calcium-aluminium and calcium-silicate hydrates in different states of hydration, with changes in lattice spacing on dehydration, has practical significance in its possible connection with the shrinkage of set cement.

Dr Roberts next discussed the action on concrete of sulphate solutions, and outlined the recent work on the quaternary system, lime–alumina–calcium chloride–water, and the corresponding system containing ferric oxide. This system is important because of the danger of adding calcium chloride to concrete in which steel rod is to be embedded. The higher the amount of calcium chloride remaining free in the aqueous phase, the greater the risk of corrosion. Fundamental studies of the relevant calcium chloride–water systems show the extent to which the salt is free or combined in concrete and indicate how the composition and conditions of curing of concrete, when chloride is present, influence the extent of corrosion of embedded steel.

After the lecturer had answered a number of questions Mr S. J. Chard proposed the vote of thanks.

CUMBERLAND AND DISTRICT

Baking, Confectionery and Cooking.—The Ladies' Evening was held in the Windscale Club, Seascale, on 23 October. At this meeting, which was attended by representatives of the different women's organizations in the neighbourhood, Dr D. W. Kent-Jones, past President of the Institute, gave an interesting lecture on 'Baking, Confectionery and Cooking.' He described the various chemical reactions involved in cooking and the safeguards that are necessary to ensure successful results. His capable handling of the lecture, which was interspersed with amusing anecdotes, ensured an enjoyable evening for all. The vote of thanks was proposed by Mrs B. Woodman of the Seascale Women's Institute.

EAST ANGLIA

Human Nutrition.—At a joint meeting with the Norwich Medico-Chirurgical Society on 25 November, Dr W. F. J. Cuthbertson gave a talk on 'Human Nutrition —some important Present-day Problems.'

Dr Cuthbertson described his experiences and difficulties in developing a food supplement to prevent a deficiency disease known as kwashiorkor, which is prevalent among children in the tropical rain-belt area of Nigeria. The disease is due to protein deficiency caused basically by the absence of protein-containing crops which are sufficiently high-yielding to sustain the population. Animal husbandry, and the growing of large quantities of protein-containing crops, are ruled out by local conditions, and the problem was solved only because modern communications now make possible the import of ground nuts from Northern Nigeria. From these a protein concentrate can be prepared for addition to the mashes of cassava, yam or cornflour on which the infants are normally fed.

Dr E. C. Wood took the Chair, and Mr A. J. Eddy, President of the Medico-Chirurgical Society, proposed the vote of thanks.

Ladies' Evening.—On 8 and 9 December, Ladies' evenings were held in Ipswich and Norwich. Both meetings were addressed by Mr K. West of Imperial Chemical Industries Ltd, who spoke on 'Terylene.'

Mr West sketched the history of artificial textile fibres and showed how nylon and Terylene both developed from Carothers' original work on polyesters. He explained how the properties of these and other fibres were connected with their molecular structure. The effect of molecular structure on the second-order transition temperature is of particular importance, since many properties differ above and below this temperature. In particular the rate of dye uptake by Terylene only becomes appreciable above about 80°C. Above this point, too, Terylene can be permanently creased; whereas at lower temperatures it resists wrinkling.

At the Ipswich meeting, Dr F. C. Lloyd took the Chair and also proposed the vote of thanks on behalf of members and guests. At Norwich these duties were carried out by Dr Wood and Professor J. C. Earl respectively.

EDINBURGH AND EAST OF SCOTLAND

Lister Memorial Lecture.—The first meeting of the new session was held on 1 October when members attended the 6th S.C.I. Lister Memorial Lecture, given by Dr Nathan B. Eddy, entitled 'Chemical structure and action of morphine-like analgesics and related substances.' The vote of thanks, which fully expressed the audience's appreciation of a most interesting lecture, was proposed by Dr B. Raistrick.

Polymerization. A joint meeting with the other chemical societies was held on 29 October, when Dr Manfred Gordon of the Arthur D. Little Research Institute lectured on 'Stereospecific Polymerization and Tactic Polymers.' In his lecture, Dr Gordon selected two topics for discussion, one to do with the mechanism of heterogeneous polymerization and the other from the field of structure/properties relations in tactic polymers built up by such polymerization processes. After an interesting discussion, the thanks of the Section were expressed by Dr F. N. Woodward, C.B.E.

Nitrogen Fixation. On 12 November Dr E. R. Roberts of Imperial College, London, gave a lecture entitled 'Some Unanswered Questions on the Biological Fixation of Nitrogen.' Professor E. L. Hirst, C.B.E., F.R.S., Chairman of the Section, took the Chair.

Dr Roberts explained that at Imperial College a strict physico-chemical approach had been adopted in the quantitative measurement of the effect on fixation by various substances which are thought to occur in its metabolic pathway. Most of the information on this subject had been obtained from studies of inhibition—the rate of nitrogen uptake being accurately measured by an isotopic dilution method. Dr Roberts concluded

by discussing possible fixation mechanisms and the prospect of efforts to produce model systems. After a lively discussion, the vote of thanks, proposed by Dr H. C. Oldland, was heartily accorded by the audience.

GLASGOW AND WEST OF SCOTLAND

Petrol Refining. At a joint meeting with local members of the Society of Chemical Industry, the Society for Analytical Chemistry and the Chemical Society at the Royal College of Science and Technology on 4 December, the President of the Institute, Mr E. LeQ. Herbert, delivered an address on 'Petroleum Refining: A Chemist's view of Today and Tomorrow.' Dr W. A. Caldwell was in the Chair.

The President reviewed the development of the petroleum industry from its early days to modern times. He discussed the trend in requirements for raw materials and monetary investment and illustrated with slides a typical chemical plant of impressive design. Mr Herbert indicated that petroleum chemistry was essentially experimental in nature because of the search for improved fuels and the rapidly expanding production of chemicals from petroleum. Suitable raw material must be forthcoming from the refineries for petroleum chemicals to be economically successful. The manufacture of glycerol and detergents of the alkylsulphonate type was given as a typical example.

The President ended his address with an optimistic view of the future for petroleum. Dr J. Sword proposed the vote of thanks.

HUDDERSFIELD

Mechanism of Dyeing with Procion Dyes. On 18 November Mr H. H. Sumner of Imperial Chemical Industries Limited (Dyestuffs Division), delivered a lecture on 'Procion Dyes' at a joint meeting with the Chemical Society of the Huddersfield College of Technology. The Chairman, Mr B. Ozog, thanked the lecturer. A summary of the lecture will be given shortly.

HULL AND DISTRICT

Newer Reactions of Fatty Acids. On 7 December, a Joint Meeting was held with local members of the Oil and Colour Chemists' Association and the Society of Chemical Industry.

Unfortunately Dr J. Weiss, of the Royal Institute of Technology, Stockholm, who was to have lectured on 'Some Newer Reactions of Fatty Acids and their influence on Paints and Varnishes,' was absent through illness and his paper was read to the meeting by Mr A. Done. It dealt with the properties of aluminium soaps and alkylates in paints and varnishes. The advantage of shorter drying time was well illustrated with slides giving actual results, and it was established that certain non-drying oils could, by the use of aluminium alkylates, be converted to slow-drying oils, and slow-drying to quick-drying oils. The ability of varnish films to resist water-absorption could also be improved by the use of these synthetic drying agents.

Questions on the paper were taken down for transmission to Dr Weiss.

Gas Chromatography and Fatty Oils. The reading of the paper was followed with one by Dr R. V. Crawford, Research Department, Messrs J. Bibby & Sons Limited, on 'Gas Chromatography for the Routine Examination of Fatty Oils.' Dr Crawford explained the advantages of the gas-chromatographic method, particularly with regard to the speed at which the amounts of various unsaturated acids could be determined in samples of the order of 1 mg or less. The equipment with which Dr Crawford was familiar for carrying out gas-chromatographic analyses was described in considerable detail, including the use of argon detectors and capillary columns.

Numerous questions were asked after the lecture, and it was obvious that a considerable amount of thought had been stimulated on the subject.

The Chairman was Mr A. W. Dixon (Oil and Colour Chemists' Association), and the vote of thanks was proposed by Mr L. Malin.

LEEDS AREA

Annual General Meeting. At the A.G.M., held at the University of Leeds on 16 November, 1959, the Section was honoured by the presence of the President, Mr E. LeQ. Herbert. Under the chairmanship of Mr R. K. K. Fourness, the Report and the Financial Statement were adopted. Dr D. McNeil and Messrs J. G. Hopkinson, D. Pedder and W. F. Stone were elected to the Committee; Messrs J. T. Thompson and A. Woodmansey were re-elected Hon. Auditors. After welcoming individually those members of the Section who had been elected to corporate membership during the past year, the President said that the strength of the Institute lay in the hard core of the Local Sections. We all owed a great deal to the devotion of the corporate members throughout the years, and he hoped that those now coming forward would take their part in the work. He congratulated the Section on the fact that all the nominations for Committee had been sent in by private members.

A member expressed appreciation of the Council's initiative in organizing the remuneration survey, and suggested that it might be still more helpful if in future the figures could indicate when a member's income was derived from more than one source in the profession, since otherwise the actual levels of salaries tended to be obscured.

The Chairman conveyed the thanks of the Section to the retiring Members of Committee.

The President then gave a lecture on 'Petroleum Refining: a view of today and tomorrow.' His fascinating survey of the history, achievements and

probable future development of the petroleum industry greatly interested his audience and presented a new conception of the present-day scale of chemical production and the potentialities of the industry as the world's major source of energy. A lively session of questions and discussions ensued, and Dr C. G. Addingley expressed the appreciation of the members to Mr Herbert.

After the meeting the President was entertained to dinner by the Section Committee.

LONDON

Annual Dinner and Dance. The 11th annual Dinner-Dance of the Section was held at St Ermin's Hotel on 16 October, and Mr F. C. Hymas, Chairman, accompanied by Mrs Hymas, was present. The principal guests were the President and Mrs E. LeQ. Herbert and Professor and Mrs H. J. Emeléus.

The toast of 'The Royal Institute of Chemistry' was proposed by Dr J. H. Pryor, Senior Vice-President of the Section. In a very cogent speech he drew attention to the desirability of better lines of communication and greater co-operation between teachers in schools, universities and technical colleges, which he regarded as a matter of some urgency. The problems created by the differences in salary between teachers of chemistry and industrial chemists would have to be resolved before the present shortage of teachers could be made good.

The President replied with a speech that had its lighter touches, and reminded his listeners that he had been associated with the petroleum industry long enough to remember the time when petrol was its most sought-after product, but fortunately not so long as to remember when paraffin was the industry's main product. He congratulated the Section on the important part it had always played in the development of The Royal Institute of Chemistry and instanced the Summer School in Analytical Chemistry and the *Film Index*.

The toast to 'The Guests' was proposed by Mr Hymas and Professor Emeléus briefly responded.

Education and Training of Chemists. Mr D. G. Chisman, Education Officer of the Institute, gave a lecture on 'The Education and Training of Chemists' to a joint meeting of the Section and the S.E. Essex Technical College Scientific Society at the College on 20 October. Mr Hymas was in the Chair.

Mr Chisman drew attention to the expansion required in the training of scientists and technologists during the decade 1960–70. He then reviewed the various routes to professional qualification, mentioning the well-established university courses and the increasingly important technical college courses. He explained the entrance requirements for the various courses and depicted diagrammatically the approximate equivalence of different qualifications at various levels.

Mr Chisman referred to recent trends in the education and training of chemists, mentioning certain changes introduced by the Council of the Institute in recent years. In particular, he referred to the new Regulations introduced in 1956, the special relationship scheme, the recognition of the Dip. Tech. in certain instances as equivalent to an honours degree in chemistry for exemption purposes, and the new Institute Research Diploma.

The lecture was followed by a long and lively discussion.

The vote of thanks was proposed by Mr J. Ratcliffe and Mr Hymas expressed thanks to the college authorities.

Recent Advances in Plant Biochemistry. At a meeting on 21 October at King's College, Mr Hymas took the Chair and introduced the speaker, Dr D. D. Davies.

Dr Davies said that the field of plant biochemistry was so vast and the rate of development so fast that he would confine his remarks to the 'bio' aspect of enzyme chemistry in plants.

He began by explaining the Krebs cycle, and its operation in relation to plant structure.

The three-dimensional fixing of a molecule at an enzyme surface is responsible for the production and use of specific optically-active isomerides; and the specific catalysis of one reaction in a sequence, by one enzyme only, is responsible for the fact that all reactions in the sequence can occur in free aqueous solution.

The Krebs cycle, in addition to being a catalytic respiratory mechanism, is also a biosynthetic cycle, leading to the production of aspartic and glutamic acids from oxalo-acetic and α-oxoglutaric acids, respectively. The production of these amino acids, which is proportional to the rate of protein synthesis, necessitates a replenishment of their precursors within the cycle, this being achieved by the fixation of carbon dioxide in malic acid.

The balance between reduced coenzymes, necessary for reductive carboxylation, and oxidized coenzymes, necessary for the oxidative decarboxylations occurring within the Krebs cycle, is maintained by the two specific coenzymes and by the separation of the two systems by a double-walled membrane.

The lecturer then described the process of control of reaction rates within a cycle by metabolic products, which slow down enzymic processes earlier in the chain of reactions, thereby functioning as a negative feed-back mechanism.

Dr Davies then dealt with the mode of operation of a 'mosaic system' of enzyme–protein complexes in a definite pattern; reaction products tend to pass along a chain of reaction sites so located that the product of any reaction is suitably sited for the next enzymic process.

Evidence for this type of system has been drawn from attempts to purify particular enzymes, a pure enzyme being virtually impossible to isolate, as it is closely associated with its immediate neighbours in the 'reaction chain.' Dr Davies gave examples of sugar metabolism to illustrate these points.

Finally, the lecturer mentioned further investigations in the isolation of enzymes and the application of ultracentrifuge techniques to plant extracts.

The vote of thanks, proposed by Dr S. A. Miller, was carried with acclamation.

Research and Development in D.S.I.R. Stations. A meeting was held at the Medway College of Technology, Chatham, on 27 October. Mr Hymas took the Chair and introduced the lecturer, Sir Harry W. Melville, K.C.B., F.R.S., Secretary to the Department of Scientific and Industrial Research, who spoke on 'Research and Development in D.S.I.R. Stations.'

Sir Harry said that the 15 D.S.I.R. research stations, with an annual gross expenditure of about £6 m, employed about 5,250 people. Chemistry played a dominant role in many of the Department's problems, even those of a purely engineering character. After enumerating the stations, he went on to discuss some of the more interesting current problems.

At the National Chemical Laboratory work on ion-exchange resins had started in 1925 under Professor Morgan, but took on a new look after the second world war. One application, in the extraction of uranium from ores, resulted in far cheaper metal than could otherwise have been obtained. Then followed an interesting description of the way specific resins were developed, with an indication of the large field that was opened up by their use. Preparation of highly pure compounds, measurement of thermodynamic properties of compounds, and extraction and purification methods (*e.g.* of germanium) were other facets of the work of this station.

The Water Pollution Research Laboratory dealt with problems of purification of sewage and effluents, which were otherwise liable to pollute streams and rivers to the detriment of natural life. This work called for the development of special apparatus at the Laboratory. A particular problem was the destruction of synthetic detergents, which not only caused severe foaming but also a build-up of the sulphonated alkylated benzenes in water.

The Fire Research Station had a very large building in which large-scale burning tests could be carried out. A proposal to attack fires chemically by suppressing combustion with inert gas discharged in large quantities by a gas turbine was a spectacular aspect of the work there.

The Building Research Station dealt with problems arising from the use of various kinds of building materials —cement, brick, stone, wood and so on—and also with investigations into the chemical structure of the materials. The use of massive concrete biological shields provided one new line of work at this station.

The Road Research Laboratory dealt with road-building materials and also with civil engineering problems and all aspects of traffic engineering. Sir Harry described the problems of skidding and tyre construction and showed how the chemical structure of rubber played an important part. In the Warren Spring Laboratory, chemical engineering problems were tackled; one of immediate industrial importance was the conversion of hydrogen and carbon monoxide with liquid hydrocarbons.

When mentioning the National Engineering Laboratory in Glasgow, the lecturer instanced the way in which chemistry impinged on engineering problems of heat exchange in copper condenser pipes in boilers. Maximum heat transfer between steam and the cold water flowing in the pipe was prevented by a thin layer of water forming on the tube. He described how film formation could be avoided by making the surface of the copper pipe hydrophobic, by treatment with a thiol, the sulphur atom of which combined with the copper of the pipe. By substitution in the chain it was possible to get various degrees of hydrophobicity. Other effects, such as stability of film, presence of impurities in the steam, scouring action and so on had to be examined, and so far it had not been possible to duplicate the effect on steel pipes.

Lastly Sir Harry mentioned the Torry Research Station where problems of fish preservation were examined. He illustrated how unsaturated components of fats (especially conjugated chains) oxidized to give hydroperoxides, producing rancid odours and flavours, and went on to describe the tests done on the smoking of fish and the use of anti-oxidants to prevent or control the production of hydroperoxides.

After the lecture a number of questions were asked and Sir Harry reminded the audience that the D.S.I.R. existed to serve the public. If information was required it was readily available.

The vote of thanks was proposed by Mr A. H. Thorneloe and carried with acclamation.

Film Evening. A film evening was held at Borough Polytechnic, Borough Road, as a joint inaugural meeting with the Student Chemical Society on 29 October.

Members of the Institute were welcomed by the Principal, Dr J. E. Garside, who also introduced the Chairman, Mr Hymas, who expressed thanks for the welcome extended to members and said he hoped that the series of meetings thus begun would prove to be successful. He then introduced Dr Pryor who gave a short preliminary talk on the films to be shown. The films were: 'Point of New Departure,' 'Discovery of a New Pigment,' 'History of the Discovery of Oxygen,' and 'Refinery at Work.' The vote of thanks was proposed by a member of the Student Chemical Society.

Synthetic Fibres. Dr R. Johnstone, of Courtaulds Ltd, gave a lecture on 'Synthetic Fibres' at Norwood Technical College on 4 November. The proceedings were opened by Mr V. Hillman, Principal of the College, and the Chair was taken by Dr Pryor.

Dr Johnstone preferred to call man-made fibres 'synthetic' rather than 'artificial,' distinguishing between truly synthetic and regenerated fibres.

The truly synthetic fibres described in some detail were nylon, Terylene and the acrylics (Orlon, Dynel, Chemstrand, Acrylan and some others). The chemical principles involved in polymerization were illustrated, and nylon was actually prepared by interfacial reaction of adipyl chloride in carbon tetrachloride with hexamethylenediamine in water.

The polymerization of acrylonitrile in aqueous solution by means of potassium persulphate and silver nitrate was also demonstrated, as well as the spinning of a thread of polyacrylonitrile from its solution in dimethylformamide. The principles behind the dyeing of synthetic fibres were also explained.

Dr Johnstone answered questions raised by members of the audience, and the vote of thanks was proposed by Mr M. V. Francis.

Recent Developments in Co-ordination Chemistry. A joint meeting was held with the Brunel College of Technology Chemical Society, Acton, on the evening of 5 November. Mr P. A. Raine presided.

Professor R. S. Nyholm, F.R.S., gave a survey of the various fields of co-ordination chemistry in which research is proceeding. These include studies of the nature of the metal–ligand bond and so embrace numerous problems in valency theory. The importance of the crystal field theory was stressed in regard to the transition metals. Some idea of the work proceeding on rates of chemical reactions in complex compounds was given, and reference was also made to the thermodynamic properties and particularly to stability constants and heats of formation.

The use of physical methods in the elucidation of a large number of new structures and the value of spectroscopic methods were discussed, together with an account of the different kinds of new compounds being isolated and current work on new and rare metals, new oxidation states and unusual co-ordination numbers.

The speaker then proceeded to discuss complexes of metal carbonyls with ditertiary arsines and their halogen oxidation products. In particular, several new 7-covalent compounds of bivalent molybdenum were described.

After a short discussion, Dr J. H. Skellon, Head of the Chemistry Department, proposed the vote of thanks to the lecturer.

The Search for New Drugs. On 9 November a joint meeting with the College Scientific Society was held at the Woolwich Polytechnic. Dr Pryor presided, and the lecture was given by Dr F. L. Rose, O.B.E., F.R.S., research manager, Imperial Chemical Industries Ltd (Pharmaceuticals Division), who spoke on 'The Search for New Drugs.'

In his introductory remarks Dr Rose pointed out that many erroneous ideas exist as to the manner in which drugs are discovered and developed. The view that new drugs are discovered from chance observations is quite misleading; very few useful drugs have been developed on these lines. The suggestion that drug research has an entirely rational and fundamental basis is equally erroneous; the bactericidal activity of the antibiotics streptomycin and tetracycline could not have been deduced from their molecular structures.

The search for new drugs involves the co-operation of chemists, biochemists and biologists. The function of a particular cell and the chemistry of its enzyme processes may be studied, and attempts can then be made to produce substances that will disorganize the chemical reactions taking place in the cell. The drug must be a stable, non-toxic substance, and when administered orally must resist the action of the digestive enzymes, be absorbed through the intestinal walls into the blood stream, and survive the metabolic processes of the body.

Dr Rose then described the work on Johne's bacillus that led to the isolation of a growth-promoting factor, mycobactin; the identification of *N*-hydroxylysine residues in the molecular structure of this compound; and the subsequent search for substances capable of destroying the effect of the growth factor.

The lecturer then went on to discuss the anti-tubercular activity of Bunte's salt, and the recognition of ethyl mercaptan as being the effective chemotherapeutic agent. The use of diethyl thio-isophthalate as a potential anti-tubercular drug was referred to, as well as its application in the treatment of leprosy.

Finally, Dr Rose emphasized that the activity of a drug depends very greatly on its persistence in the animal body and also on the rate of absorption: the effect on these factors of substituting various groups into sulphanilamide was discussed.

Following an interesting discussion, Dr S. R. Landor proposed the vote of thanks to the lecturer, and Dr Pryor thanked the College authorities for the facilities provided.

Chemistry of the Silicones. At a meeting held at Croydon Technical College on 12 November, Mr Kelsill, the Vice-Principal, welcomed the Section and introduced the Chairman for the meeting, Mr A. J. Turnbull, who called upon Dr F. C. Saunders to deliver his lecture.

After a brief account of F. S. Kipping's work that began some 60 years ago at Nottingham, Dr Saunders outlined the nomenclature of the 'organic' silicon compounds before discussing the synthesis of the polymeric silicone compounds. These have the basic siloxane chain, $-O-\underset{|}{\overset{|}{Si}}-O-\underset{|}{\overset{|}{Si}}-O-$, terminating with $-SiMe_3$ or similar groups. Polysiloxanes may have a straight or branched chain or may have cross-linkages between chains. The cross-linked polymers may be solids or viscous fluids depending on the degree of cross-linking:

the simple chain polymers are fluids whose viscosity increases generally with their molecular weight. Silicone gums are linear polymers of high molecular weight; silicone resins have cross-linkages between siloxane chains; silicone rubbers are gums that have been compounded with fillers and a catalyst (usually an organic peroxide) that enables them to form cross-linkages on heating to give a cured elastomer.

The chlorosilanes are the starting point for the synthesis of all silicone polymers. In the 'direct' method of Rochow a stream of alkyl or aryl halide is passed over silicon in the presence of a suitable catalyst (*e.g.* Cu) at 250°–300°C.

Conditions are usually adjusted to give the maximum yield of the dichloro derivative. The mixed alkylchlorosilanes are separated by distillation. A Grignard process can also be used.

Hydrolysis of the chloro compounds yields the corresponding silanols, which by intermolecular condensation give siloxanes. The three general classes of silanols are the monofunctional R_3SiOH 'end-stoppers,' the difunctional $R_2Si(OH)_2$ 'chain propagators' and the trifunctional $RSi(OH)_3$ 'cross-linkers.' The chain-length of the polymer can be regulated by introducing the correct proportion of end-stopper into the reaction mixture before condensation. Reaction mixtures for gums are essentially chain propagators free from mono- and tri-functional compounds: resins are made from reaction mixtures containing some trifunctional compounds to produce cross-linkages.

The properties of silicones were then described, with particular reference to their stability to heat, low volatility, low surface tension, low adhesion and cohesion, low viscosity/temperature coefficient, excellent electrical insulation properties and resistance to attack by many chemicals (but not by strong acids or alkalis).

These properties have been used in many ways. Textiles and building materials can be made water-repellent. Silicones can be used as release agents in tyre-moulding and bread-baking; as plastic/plastic and rubber/rubber lubricants (though not for metal/metal); as the vehicle in heat-stable paints; and as insulation for the windings of hot-running electric motors. Silicone rubbers do not soften or harden like other rubbers at extremes of temperature; silicone insulating compounds do not support combustion and are non-tracking because on decomposition they yield silica.

The properties of silicones and silicone-treated materials were demonstrated in a series of very convincing experiments which preceded a discussion in which nine members of the audience took part. In reply to questions the lecturer said that 'bouncing putty,' which he had just demonstrated, had been used as a core for golf balls; the heat stability of silicones could be increased by substituting aryl groups for alkyl groups in the chlorosilanes used in making the polymers; promising results had been obtained by the introduction of –F and –CN groups in the side-chains to give increased solvent resistance; siliconized paints were more resistant to some types of atmospheric corrosion than ordinary paints and conferred on glossy surfaces some resistance to stain and dust. He also discussed the mechanism of the 'direct process' and the possibility of the formation of cross-linkages in polyphenyl siloxanes.

After the vote of thanks had been proposed by Dr Macey, Mr Turnbull proposed the vote of thanks to the College Governors.

MANCHESTER AND DISTRICT

Chairman's Address: '*Magnesium.*' At the first meeting in Manchester this session, on 12 November, Dr S. J. Fletcher gave the Chairman's Address—'Magnesium.' Dr Fletcher was introduced by Dr L. R. Ridgway, the present Chairman of the Section.

Dr Fletcher said that he was pleased to have the opportunity of talking about magnesium, because even though hundreds of thousands of tons of this metal have been used for a wide variety of purposes during the last 30 to 40 years, too many chemists, and even metallurgists, still know very little about it, and such information as they do have is often wrong. Magnesium is often regarded by the uninitiated as a metal which burns readily and very quickly corrodes. The wide use of magnesium for incendiary bombs during the war fostered this idea. Magnesium, normally in the form of alloys with other metals, is in fact an important structural material, particularly for applications where lightness is important.

Dr Fletcher then discussed in considerable detail the discovery and development of magnesium and the various methods of extraction which have been used, the major methods at present being (1) the electrolysis of anhydrous or partially hydrated chloride, (ii) the thermal reduction of calcined dolomite with ferrosilicon, (iii) the carbo-thermic method, involving the reduction of magnesium oxide by carbon.

The first structural alloys based on magnesium had small additions of aluminium and zinc or manganese. These were cheap and are still very useful, although the properties deteriorate above 150°C. In 1938 the introduction of less than 1 per cent of zirconium was found to reduce the grain size very appreciably and to improve the strength, particularly the proof strength at normal temperatures. Later, the addition of 2–3½ per cent mischmetal improved the properties up to *ca* 250°C; more recently 2–3 per cent thorium has been found to give an alloy that can be used up to temperatures of 350°C. The latest alloy, containing silver, zirconium and fractionated rare earth, has the best properties at room temperature, with good creep resistance.

Dr Fletcher then mentioned the usefulness of magnesium in nuclear reactors owing to its low neutron-capture; this was followed by a brief description of

casting and fabrication methods and a few words on surface protection. He concluded with a mention of other uses of magnesium, *e.g.* in the extraction of certain metals by reduction of their chlorides, the cathodic protection of steel structures, pyrotechnics and rocket fuels, Grignard reactions and so forth.

In accordance with custom, there was no discussion at the end of the address; the vote of thanks was proposed by Mr G. Osgood, who said that, as a wine and spirit bottler, he was particularly interested in the phenomenon that 0·1 p.p.m. magnesium causes turbidity in whisky.

Newcastle upon Tyne and North-East Coast

Recent Studies in Relation to Biosynthesis. At the first meeting of the current session on 21 October Professor A. J. Birch, F.R.S., gave a lecture on 'Recent Studies in Relation to Biosynthesis.' Professor Birch described the work at Manchester and other centres on the tracing of biosynthetic routes *in vivo*, using sodium acetate labelled with ^{14}C and explained the subsequent degradative techniques that established the locations of the labelled atoms and hence the synthetic mechanism. Professor Birch then showed, in a fascinating manner, how the biosynthetic routes and the correct structures of about 30 natural compounds, ranging from flower pigments to antibiotics, were built up from acetate and isoprene building units. Dr J. O. Harris proposed the vote of thanks.

X-ray Fluorescence Analysis and Spectrography. A most enjoyable joint meeting with the Society for Analytical Chemistry took place on 27 October. It began in the afternoon when a party visited Winthrop Laboratories, Fawdon. After tea, Mr R. A. C. Isbell, of the Society for Analytical Chemistry, introduced Mr R. C. Chirnside, their President, who, in a short address, welcomed the members and speakers.

Mr J. R. Stansfield, of Hilger & Watts Ltd, then spoke on 'Instrumental Methods in X-ray Fluorescence Analysis.' He said that when a suitable beam of X-rays falls on a material, part is scattered as fluorescent radiation characteristic of the atoms present in the material, and by isolating and measuring the intensity of the fluorescent beams a quantitative analysis of the material may be carried out. High power X-ray tubes of 2 kW operating at 50 kV provide the source and enable the K spectra of lighter, and L spectra of the heavier elements to be measured. The fluorescent radiation is dispersed in a crystal according to the Bragg law, topaz, lithium fluoride, quartz, ADP and gypsum having been used as analysers. Geiger counters, scintillation counters and proportional counters are used for measuring the intensity of the radiations, the last being particularly valuable for the light elements. The lecturer concluded by describing the modern instruments, which are almost completely automatic in operation.

Dr H. I. Shalgosky, of U.K.A.E.A., Woolwich, then spoke on 'Some applications of X-ray Spectrography.' He mentioned the determination of uranium in its ores with a lower limit of 100 p.p.m., molybdenum being used as internal standard, and of strontium in milk powder, where no internal standard is necessary. The normally difficult problem of determining small amounts of hafnium in zirconium is complicated further by the fact that the hafnium K lines coincide with those of zirconium, but by reducing the tube voltage from 48 to 17 kV only the hafnium lines are excited and, with long counts, 50 p.p.m. can be measured. Generally, this method is quicker than others, for instance, spectrographic and radioactivation analysis and flame photometry.

Dr K. H. Jack, Chairman of the Section, proposed the vote of thanks.

North Lancashire

Some Aspects of Surface Activity. At a joint meeting with the Glaxo Laboratories Scientific Society in Ulverston on 23 October, Professor N. K. Adam, F.R.S., gave a lecture entitled 'Some Aspects of Surface Activity.'

Professor Adam first reviewed the principal properties of unimolecular films of insoluble organic substances at a water–air interface. For these to be stable, there must be a water-attracting group at or near the end of a long hydrocarbon chain, or of a large amount of hydrocarbon such as the sterol skeleton. Hydrocarbons and long-chain alkyl halides do not form stable films; but carboxylic acids, alcohols, amines, amides and nitriles form very stable films, if the hydrocarbon chains contain at least 14 carbon atoms.

The lateral cohesion between the film molecules principally determines the structure of the films; if this is high, they are condensed, and if the polar ends are not too large, the long chains pack closely side by side, perpendicularly to the surface. Frequently, with rising temperature, the increasing kinetic energy of the molecules partially overcomes this lateral cohesion, changing the condensed into expanded films, in which the long chains appear to whip about, by the development of free rotation at each carbon-to-carbon link, the polar groups remaining directed towards the water. The result is a liquid-like film of hydrocarbon chain, slightly thinner than the length of the hydrocarbon chain. Further breakdown of the cohesion results in a 'gaseous' film, in which the relation between the surface pressure and area is closely similar to that between pressure and volume in a three-dimensional gas. Ionization of the polar end-groups decreases the lateral cohesion through repulsion between the similar electric charges on these groups.

At oil–water interfaces, and also for adsorbed films of most surface-active agents, which are soluble in water,

the interfacial films are practically always of the gaseous type.

Foams depend for their stability on possessing the power of varying their surface tension, at least temporarily, when the foam lamellae are extended or compressed. Pure liquids, even of very low surface tension, such as some fluorocarbons for which the tension is about 15 dyn/cm, do not foam.

When the lamellae increase in area, the surface-active molecules are thinned out in the surface, so that the tension rises, because these molecules diffuse more slowly to the surface than water molecules, and (if the lamellae are sufficiently thin) because the reserve-active molecules in the interior of the lamellae are partially exhausted. Anti-foams act by displacing the surface-active molecules from the surface and destroying the power of varying the tension with changes in area.

Emulsions are similar to foams, except that the dispersed phase is a liquid, not a gas. Low surface tension assists emulsification, and most theories of emulsification dwell on the properties of the interfacial film. Insufficient attention, in the lecturer's opinion, has been paid to the importance of the stability of the lamellae of the continuous phase between two droplets of the disperse phase, when these approach closely. Hildebrand (*J. phys. Chem.*, 1941, 1303) showed the importance of the emulsifying agent being present in the continuous phase, and therefore in these lamellae: this explains why oil-soluble agents favour water-in-oil, and water-soluble agents oil-in-water emulsions—a well-known fact whose explanation is not at all widely known. For oil-in-water emulsions, the stability is increased if the emulsifying agent has electrolytically dissociated end groups, since approaching droplets then repel each other.

The lecturer also referred to the use of unimolecular films of cetyl alcohol in reducing the rate of evaporation of water from reservoirs in hot, dry climates.

After a very lively discussion, Dr A. P. Best proposed the vote of thanks.

Annual Dinner. The fifth Annual Dinner of the Section took place on 30 October. The Dinner was held in the Bull and Royal Hotel, Preston, and Dr F. Hartley, Vice-President, Mr L. W. Winder, Assistant Registrar, and newly-elected Associates were the guests of the Section.

After an excellent meal Dr Hartley spoke briefly of the establishment and consolidation of the Section, and later a musical trio entertained.

Film Show and Sherry Party. On 9 December members, their wives and friends attended a film show and sherry party in the Bull and Royal Hotel, Preston. This was a new venture for the Section and was greatly appreciated by members.

The first film, 'Oil for the Twentieth Century,' was followed, after an interval for sherry, by 'Babes in Sportland' and the 'Rival World.'

The first and last films were presented by courtesy of the Petroleum Films Bureau.

North Wales

Annual Dinner. This function was held on 6 November at the Blossoms Hotel, Chester. Mr E. V. Weekes, Vice-Chairman of the Section, presided and the guests included Mr E. LeQ. Herbert, President, and Mrs Herbert, and Dr S. J. Kennett (University of Liverpool) and Mrs Kennett. Mr Herbert proposed the toast to 'The Local Section,' to which Mr Weekes replied. The toast of 'The Guests' was proposed by Mr S. McLintock and Dr Kennett replied.

Sheffield, South Yorkshire and North Midlands

Chemistry in Fruit and Vegetable Canning. On 19 November, Dr D. Dickinson, of the Fruit and Vegetable Canning and Quick Freezing Research Association, gave a lecture to a joint meeting with local members of the Chemical Society and the University Chemical Society. Dr Dickinson said that the raw materials used for canning are basically the same as those entering the domestic kitchen, although the varieties of fruit and vegetable may well be different. The methods of preparation are merely mechanized forms of domestic preparation. The tinplate can is filled and sealed hot so that it maintains a vacuum within it after heat-sterilization and cooling. The aim of canning is to maintain the cooked foodstuff unchanged in its container for a considerable time. All fruits and vegetables being more or less acid, there is immediate slow interaction between the exposed metal and the can contents. As a result, red-coloured fruits may not be packed in plain tinplate cans, because the small amount of tin that dissolves is sufficient to change the natural red colouring matter into a blue complex.

To avoid this, a lacquer or enamel barrier is introduced. It is necessary to apply this lacquer to flat sheets of tinplate, with the result that it becomes damaged when the plate is made into cans. Over the more severely tooled areas the lacquer is often fractured; so also is the underlying layer of tin, so that the steel base is exposed to direct attack by the contents. This is more serious than the interaction with a tin surface because hydrogen is a direct product. It diffuses in solution from the cathodic areas and distributes itself throughout the contents. After a year or two sufficient hydrogen pressure accumulates to distend the ends of the can; when this pressure is released on opening, the dissolved hydrogen within the fruit is released from solution and causes disintegration of the tissue. The whole corrosion process is controlled by concentration polarization.

Stone-fruits contain emulsin in their kernels; if this is not inactivated by the heat process, it hydrolyses the

amygdalin present and releases a minute amount of hydrogen cyanide, which continuously relieves the polarization of the anodic areas. Corrosion has been found to be directly proportional to the residual emulsin activity in stone fruits. This depends both on the heating process and on the origin of the fruit, and is thought to be the only known example of a corrosion process directly accelerated by enzyme activity.

Dr A. S. C. Lawrence was chairman at the meeting, and after a lively discussion the vote of thanks was proposed by Mr G. Robinson.

THAMES VALLEY

Annual General Meeting. The A.G.M. of the Section was held on 23 October at the University of Reading. Drs C. H. Bamford, P. F. Holt, W. J. Kramers and R. N. C. Strain retired from the Committee, and the following Officers and Members of Committee were elected for 1959–60: Chairman, Dr D. T. Lewis; Vice-Chairman, Dr F. M. Brewer; Hon. Secretary-Treasurer, Dr E. S. Lane; Assistant Secretary, Dr A. D. Jenkins; Hon. Recorder, Mr J. A. Radley (Reading); Members of Committee, Messrs L. Airey (N.G.T.E.), W. E. Hankey (Maidenhead), F. A. Lyne (Reading), D. H. McLean (Abingdon), and Dr F. H. Grimbleby (University of Reading).

After the business meeting Dr H. J. M. Bowen, of the Technological Irradiation Group, Isotope Research Division, Wantage Radiation Laboratory, gave a lecture on 'The Biological Applications of Radiation.' He first discussed the reasons for studying the biological effects of radiation and their application in a number of fields, and went on to describe, with the aid of some excellent slides, the types of radiation sources available. He showed that the general course of biological development with increasing dose was stimulation, mutation, sterilization, growth prevention, death and eventually chemical decomposition. In discussing the various stages of biological degradation the possible industrial applications to the preservation of foodstuffs were emphasized. Foods, normally sterilized by steam or heat, can be made sterile by the correct dosage of radiation, applied at room temperatures. Thus, they may be preserved during cold storage, strawberries being an instance where this technique may be of value. Insect pests can be controlled by radiation since this alters the ratio of males to females in the progeny of those insects which escape destruction and leads to a much reduced breeding rate in the next generation. A lively discussion took place after the talk, and Dr F. H. Grimbleby proposed the vote of thanks to Dr Bowen for his fascinating and beautifully illustrated lecture.

EAST AFRICA

Hormones from Uganda Yams. At a joint meeting of the Section with local members of the Chemical Society held at Makerere College on 12 November, 1959, Dr W. J. Peal, of the Department of Chemistry, gave a lecture entitled 'Hormones from Uganda Yams?' Professor M. Crawford was in the Chair.

Dr Peal reviewed briefly the historical development of our knowledge of the structure of steroid molecules. In particular the derivation of the accepted structural formulae of the principal steroid hormones was noted. He then described the isolation of the sapogenin, later named diosgenin, from a species of *Dioscorea* (yam) by Japanese workers. The structure of this compound, its availability and its ready conversion to the hormone progesterone make this substance a particularly valuable hormone precursor. Furthermore, it has been shown recently that diosgenin may be used as a precursor for cortisone, since the C_{11} oxygen function of the latter compound may be introduced into progesterone by microbiological oxidation.

The lecturer described a survey of the sapogenin content of Uganda yams which is being carried out in the Makerere Laboratories. The problem is both botanical and chemical, as many of the Uganda Dioscorea spp. are inadequately identified. To date 12 species have been identified and there are three species awaiting identification. Previous work on the yams of Uganda records only 11 species. Of the species found, four contain diosgenin and one yamogenin, but in no case is the yield greater than about 0·3 per cent, which is too low to offer the possibility of exploitation.

During the extraction of diosgenin from yams a second substance was always found, and this was characterized as 25*D*-spirosta-3:5-diene. It was shown to be an artefact formed by dehydration of the diosgenin during the acidic hydrolysis of the saponin. The importance of careful control of acid strength during the extraction was discussed.

In conclusion the lecturer outlined possible mechanisms of the acid-catalysed dehydration of diosgenin and other 3β-hydroxy-Δ^5-steroids.

DECCAN

Vitamin A and Carotenoids. A meeting was held on 27 November in the General Chemistry Lecture Hall of the Indian Institute of Science, Bangalore. Dr J. Ganguly, of the Department of Biochemistry, Indian Institute of Science, gave a lecture on 'Absorption, Transport and Storage of Vitamin A and Carotenoids.' Professor P. S. Sarma was in the Chair.

Dr Ganguly gave an account of the experimental evidence he and his co-workers had collected over a period of several years, to explain two most interesting observations on the metabolism of vitamin A and carotenoids; (i) that animals show a remarkable selective ability in the absorption and storage of different carotenoids; thus most animals do not have any carotenoids in their tissues, cattle have mostly hydrocarbon-carotenoids, and birds mostly hydroxy-carotenoids, while

man has both hydrocarbon- and hydroxy-carotenoids; and (ii) that animal livers have a rather limited capacity to store vitamin A alcohol, whereas they can accumulate very large amounts of the esterified form of the vitamin.

He said that all the vitamin A, both ester and alcohol, present in rat liver could be salted out by treatment of the supernatant liquid, obtained from the liver homogenate by high-speed centrifugation, with ammonium sulphate or with cold ethanol and that a partial separation of the two forms of vitamin A could be achieved by dialysing the liver supernatant liquid against a series of buffers of different pH values. The fat solvents could extract the vitamin from the liver supernatant liquid only when the proteins had been denatured by treatment with ethanol or by application of heat. Blocking of the Kupffer cells by an injection of Indian ink prevented the accumulation of the esterified form of vitamin A, but the concentration of the alcohol form remained unchanged. These observations would suggest that vitamin A ester and alcohol are stored in association with separate specific lipo-proteins in the Kupffer cells and parenchymal cells of the liver, respectively.

Dr Ganguly further observed that when chickens were dosed with β-carotene, lycopene and lutein, only lutein could be found in appreciable concentrations in the mucosal cells and in the intestinal muscles of the chicken, the other carotenoids being totally absent. On the other hand, when rats were similarly treated, none of the carotenoids appeared in any of the tissues. The lutein in chicken intestine could not be extracted by fat solvents without denaturation of the proteins.

In conclusion, the lecturer summarized the position by saying that the presence or absence of specific lipoproteins in animal tissues capable of combining with vitamin A and different carotenoids might possibly determine their absorption, transport and storage. The lecture was illustrated with slides.

MALAYA

Changes in Section Committee. Upon the departure of Mr D. J. Williams and Mr R. Phillips from Singapore, Mr I. N. Dickson has taken over the office of Chairman and Dr W. Rintoul that of Hon. Secretary until the next Annual General Meeting.

NORTHERN INDIA

Annual General Meeting. At the 9th A.G.M. of the Section held on 3 November at the University of Delhi, the following Officers and Members of Committee were elected for the year 1959–60: Chairman, Professor T. R. Seshadri; Vice-Chairman, Professor R. B. B. Viswa Nath, C.I.E.; Hon. Secretary-Treasurer, Dr S. K. Mukerjee; Members of the Committee, Drs K. B. L. Mathur, S. Raychaudhuri, G. S. Saharia, H. A. Shah and T. A. Venkitasubramanian and Mr S. Saha. Dr G. S. Saharia was elected Hon. Auditor.

News and Notes

COURSES AND AWARDS

Chemistry of the Non-Metals.—A postgraduate course of nine lectures on 'Newer developments in the chemistry of the non-metals' (particularly boron, silicon, phosphorus and fluorine) will be held at Kingston Technical College, beginning on 27 January. The fee for the course is 22s. 6d. Further particulars may be obtained from the Principal, Kingston Technical College, Fassett Road, Kingston-upon-Thames.

Radiochemistry for Public Analysts.—A second School (*J.*, 1959, 452) has been arranged by the Leicester College of Technology and Commerce, and particulars may be obtained from the head of the School of Chemistry.

Membership of the College of Technologists (M.C.T.).—A memorandum about the new M.C.T. award has been issued by the College of Technologists. This award, which was first announced by the National Council of Technological Awards in October, 1958 as 'an award higher than the Diploma in Technology,' will normally be made for a programme of work satisfactorily carried out jointly in industry and at a college. The programme may be concerned with any technological aspect of industrial activity, not only research but also development, design, production or market investigation. The nature of the programme must be such that it is likely to result in a useful contribution to technological knowledge and that it requires industrial experience and academic study extending over a period of at least three years.

The College of Technologists will demand a high standard of those who wish to register as candidates for Membership. Registration, which must be made through the Principal of the technical college concerned, will not be restricted to holders of the Diploma in Technology, but will be extended to others who are deemed to have an equivalent qualification.

The Harrison Memorial Prize.—The Selection Committee, consisting of the Presidents of The Chemical Society, The Royal Institute of Chemistry, The Society of Chemical Industry, and The Pharmaceutical Society, will, in 1960, consider making an award of the Harrison Memorial Prize.

The Prize, a bronze plaque and 100 guineas, will be awarded to the chemist of either sex who, being a natural-born British subject and not over 30 years of age, shall, in the opinion of the Selection Committee, during the five years ending 1 December, 1959, have conducted the most meritorious and promising original investigations in chemistry and published the results of those investigations in a scientific periodical or periodicals.

Applications, five copies of which must be submitted, should include the full names of the applicant; age (birth certificate to be enclosed); degrees (with name of university); any other qualifications and experience; titles, and reprints if available, of published papers (with co-authors' names); where research was carried out; testimonials and references, and any other relevant particulars.

The Selection Committee is prepared to consider applications, nominations or information as to candidates who had not attained the age of 30 years at 1 December, 1959, and are otherwise eligible for the Prize. Any such communication must be received by the President, The Chemical Society, Burlington House, Piccadilly, London, W.1, **not later than 1 September, 1960.**

MEETINGS AND CONFERENCES

Combustion Research Colloquia.—Visitors are welcome to attend the Colloquia in the Department of Chemical Engineering, Imperial College of Science and Technology, of which six have been arranged for the Spring Term, 1960. The first of these will be held at 3.45 p.m. on Monday, 18 January, when Mr M. Nettleton will speak on the pyrolysis of acetylene. Further details can be obtained from Dr J. H. Burgoyne, Department of Chemical Engineering.

Corrosion Group Conversazione.—The Corrosion Group, Society of Chemical Industry, has arranged a Conversazione to be held on 21 January in the Battersea College of Technology, S.W.11, at 6.30 p.m. Exhibits will be arranged in the Great Hall of the College, and special emphasis will be given to methods of combating marine corrosion. A short address will be given by Sir Victor Shepheard, K.C.B. A buffet supper will be provided.

Tickets (5s. each) may be obtained from the Assistant Secretary, Society of Chemical Industry, 14 Belgrave Square, London, S.W.1.

Institute of Physics.—The Non-Destructive Testing Group of the Institute of Physics will hold a meeting jointly with the Société Française de Metallurgie in London on 2–4 May. The programme will have as general theme the relationship between structure and physical properties of materials and will include recent advances in non-destructive testing techniques. Further details are available from the Secretary, The Institute of Physics, 47 Belgrave Square, S.W.1.

Levinstein Memorial Lecture.—The 5th Ivan Levinstein Memorial Lecture will be given by Mr L. H. Williams in the Large Chemistry Theatre, The University, Manchester on 5 February, at 6.30 p.m. He will take as his subject 'The Future of Chemicals from Petroleum.' The lecture is open to all interested persons and further particulars may be obtained from the Society of Chemical Industry, 14 Belgrave Square, London, S.W.1.

Plastics Institute Meetings.—The 11th Annual Lecture of the Plastics Institute will be given by the Earl of Verulam on 7 April. The subject of the lecture will be 'The Brink of the Unknown' and the meeting will be held in the Reardon Smith Lecture Theatre, National Museum of Wales, Cardiff, at 6.30 p.m. Further particulars may be obtained from the Plastics Institute, 6 Mandeville Place, W.1.

The inaugural meeting of the Education Discussion Circle was held at Brunel College of Technology on 26 November, 1959, when the Plastics Institute's requirements for practical course work were discussed by teachers from colleges where courses in plastics technology are provided.

Royal Society of Health.—The Health Congress will be held in Torquay from 25 to 29 April, 1960 and papers covering a wide variety of topics will be presented. Among the subjects to be discussed are: radiation protection in the production and transport of radioisotopes; disposal of waste products in the use of radioisotopes; control of hazards from the use of luminizing compounds; food poisoning; from farm to table: the processing of food; pollution of our rivers: is it inevitable?; smoke control and the householder; and industrial medicine's contribution to preventive medicine. Visits will be arranged to reservoirs and water purification schemes, housing estates and city developments, hospitals, research laboratories, special colleges and schools, a naval dockyard, food factories and an abattoir and market. Further particulars may be obtained from the Secretary, The Royal Society of Health, 90 Buckingham Palace Road, London, S.W.1.

South African Chemical Institute.—The 14th Annual Convention of the South African Chemical Institute will take place in Cape Town from 8 to 12 February. During the Convention there will be symposia on cosmo- and geo-chemistry; analytical chemistry; protective coatings; and practical chemistry and its teaching. Dr H. M. Irving, the guest speaker, will give an address on 'Analytical Chemistry: An Art or a Science.'

All enquiries about the Convention should be addressed to Mr N. Greenblau, Hon. Secretary, 14th Chemical Convention, P.O. Box 63, Sea Point C.P., South Africa.

Symposium on Distillation.—The International Symposium on Distillation will be held, as a meeting of the European Federation of Chemical Engineering, from 4 to 6 May in Brighton. The Symposium is intended to record and discuss information on the latest developments in distillation.

There will be four technical sessions under the general headings of heat and mass transfer; vapour–liquid equilibria; performance of packed columns; and performance of tray and other columns.

Further details and a preliminary programme may be obtained from the General Secretary, The Institution of Chemical Engineers, 16 Belgrave Square, S.W.1.

Textile Chemistry.—A symposium on 'Recent Developments in Textile Chemistry' will be held at the Bradford Institute of Technology, Bradford 7, on 13 February. Further particulars may be obtained from Dr W. R. Moore, Department of Chemical Technology, at the College.

SCIENTIFIC AND ENGINEERING MANPOWER

The Advisory Council on Scientific Policy has recently published its Second Survey of Scientific and Engineering Manpower (HMSO: Cmnd 902, 3s.). The report provides information about the numbers and employment of scientists and engineers in Great Britain at the beginning of 1959, and considers the changes that have occurred since 1956. It also includes a review of employers' forecasts of their demand for scientists and engineers by 1962.

For the purpose of the report a 'qualified' scientist or engineer is a person with one of the following qualfications: University Degree in science or engineering; Diploma in Technology; Associateship of a specified higher educational institution; Graduate or Corporate Membership of one of the professional institutions.

In the 1956 Report, the Committee hazarded an assessment of the long-term demand for qualified scientists and engineers and concluded that, as a minimum, provision should be made for an increase in numbers of about 60 per cent in the ten years 1956–66. At the beginning of 1959 the number of scientists and engineers employed in Great Britain was about 173,000, an overall increase of slightly less than one-fifth (19·7 per cent) over the number employed three years earlier. In the manufacturing industries the increase has been about 30 per cent, but in research associations, national industries and education the increase has been less than 20 per cent, and in central and local government less than 10 per cent.

According to employers' statements, there were immediate vacancies in manufacturing industry for about 9 per cent more scientists and engineers at the beginning of 1959. If employers had been able to fill these vacancies, the number employed would have approximated closely in total to the forecast of requirements they themselves had made in 1956.

The increase in the number of teachers in technical colleges has kept pace with the most recent estimates of demand. In the schools the number of science teachers has also been increasing, but there has been a relatively greater increase in the number of boys and girls studying science. In grammar schools the increase in the number of science teachers has just about been sufficient to maintain standards of science teaching, but many secondary modern schools have had to face serious difficulties.

There is, at present, no sign of any slackening in the demand for qualified scientists and engineers. Employers stated that they aim at employing 38,700 more scientists and engineers by 1962 (including those required to fill immediate vacancies); that is, a total increase of 22 per cent. In addition, more than 14,000 would be needed in the same period to replace losses from retirement, deaths and migration.

Supply forecasts indicate that the number of scientists and engineers qualifying for the first time will increase from 14,600 in 1958 to 18,500 in 1961, giving an estimated total of 47,500 newly qualified people becoming available for employment during the next three years. After allowing for replacements, the total numbers coming forward over the next three years are still likely to fall short of employers' own estimates of their needs. In particular, the shortage of mathematicians, physicists and chemists is likely to continue, though there are indications that the supply of some kinds of biologists might exceed the demand.

In 1956 the Committee assessed the long-term demand for scientists and engineers and concluded that the minimum goal should be an annual output of 20,000 newly qualified persons within the next ten or fifteen years. The rate of increase during the last three years has been higher than the Committee expected in 1956, and if this rate is maintained the number of newly qualified scientists and engineers will reach 20,000 a year by the mid-1960's.

The general conclusion of the 1959 report is that there has been a higher rate of growth in the employment of scientists and engineers than had been expected and a higher output of trained men as well.

In establishments with more than 100 employees, the number of chemists employed in 1959 was 24,300. This represents an increase of 3,400 (16·3 per cent) since 1956, but it falls short of the forecast requirement of 25,800 chemists. There has been a heavy demand for chemists in the chemical and allied trades, where the number employed (7,700) is about 40 per cent higher than in 1956. The reduction in some of the industries employing relatively small numbers of chemists (non-ferrous metals, cotton, wool, other textiles, wood and paper industries) is due to a variety of factors that cannot be easily separated.

The forecast of the additional number of chemists required by 1962 is 5,400 or an increase of about 20 per cent over the 1959 figures.

RADIATION PROTECTION

The ICRP, founded in 1928 as the International X-ray and Radium Protection Commission, expanded

to its present form in 1950. The Commission, with its sub-committees responsible for the recent publication of a booklet, *Radiation Protection,* included nearly sixty members from sixteen countries. Their new recommendations have been introduced partly with the intention of limiting the genetically significant radiation exposure of the population, and partly to limit the probability of somatic injury by reducing the integrated lifetime dose.

To these ends maximum permissible dose levels have been reduced. The ICRP previous recommendations (1955) proposed a maximum of 0·3 rem weekly for persons occupationally exposed to radiation, so that during a working life of 50 years an integrated dose of 750 rem could be received.

Subjects are considered in two groups, that is persons occupationally exposed and the population at large. For the former, the maximum permissible dose to the gonads, blood forming organs and lenses of the eyes is governed by the expression:

$$D = 5\ (N - 18)$$

where N is the age of the subject in years and D is the tissue dose in rem, including any dose from a source within the body. This implies a weekly maximum of 0·1 rem and an integrated dose during a working lifetime of 235 rem, of which not more than 60 rem should be received under the age of 30. Higher dose rates are permitted for short periods, and greater maximum permissible levels are recommended for single organs of the body and for the hands or feet.

The Commission observes that the planning of nuclear power programmes and other peaceful uses of atomic energy necessitates controlling the exposure of the whole population, partly by restricting individual doses and partly by limiting the proportion of the population exposed. It considers that a proper balance between the risk of deleterious effects and social benefits cannot be struck yet, particularly because conditions vary so much in different parts of the world. Therefore it suggests an interim ceiling for the exposure of the whole population of one-tenth of the occupational level, *i.e.* 0·5 rem annually.

The arguments which led the Commission to its conclusions are set out in detail in *Radiation Protection* (Recommendations of the International Commission for Radiological Protection. Pp. vi + 18. London: Pergamon Press Ltd, 1958. 3s. 6d. net), which includes also a useful chapter on working conditions.

L. C. MYERSCOUGH

Talanta.—The publishers of *Talanta: An International Journal of Analytical Chemistry* have announced that in order to maintain rapid publication they propose to go over to monthly publication as from January, 1960. Three volumes will be published per year and, as from volume 5, will cost 140s. per volume (£21 per annum). Further particulars may be obtained from the publishers, Pergamon Press Ltd, 4 and 5 Fitzroy Square, W.1.

Chemicals: A 'Financial Times' Survey.—On 14 December, in its most commendable account of the major branches of the chemical industry or what it claims must 'nowadays be regarded as a complex of industries,' the *Financial Times* survey presents a collective picture of 'rapid and in some cases spectacular growth, fostered by the high level of capital expenditure which is a marked characteristic of the industry.' Sir William Garrett, Chairman of the A.B.C.M., opens the survey with an article on 'The Industry's Key Role in the Economy.' This is followed with accounts of raw material supplies and coal derivatives, and articles on some 20 special groups of chemicals. Other topics considered include technical sales and advisory services, chemical engineering, the chemical industries of other countries and certain training matters. Ten of the articles were contributed by members of the Institute, though for some reason this is only indicated for the first three. A very useful and informative account for those connected in any way with the chemical industry, with industries that use its end products as raw materials or with education in science.

Dow Chemical Company (U.K.) Ltd.—The British subsidiary of the Dow Chemical Company of Midland, Michigan, U.S.A.—Dobeckmun Britain Limited—has changed its name to that given above and is to broaden the scope of its activities by taking over direct sales of Dow-produced packaging films and supervising the sales in the U.K. of industrial chemicals, plastics and magnesium produced by the U.S. and Canadian companies.

Factory People and Ourselves.—In an address given recently to the Institute of Directors, Sir Alexander Fleck, K.B.E., F.R.S., spoke on the responsibility of directors in building up an industry that was a benefit to all and brought factory and office workers more into line with one another. The pattern of society, said Sir Alexander, was changing, particularly in the highly industralized countries, and it seemed likely that in 20 years or so the arbitrary distinction between wage and salary earners would have vanished. Sir Alexander continued: 'Speaking personally, I can foresee an industrial society with a common pattern of employment conditions in which it will be difficult to distinguish between manual workers and office staff.' This did not mean that all workers would be under exactly the same conditions, for the individual merits of some would have to be recognized by more generous conditions if industrial leadership was to be encouraged.

Industrial Archaeology.—The Council for British Archaeology has recently formed a Research Committee on the subject of the archaeology of the industrial

revolution. It includes archaeologists, economic historians, geologists, architects, technologists and others interested in surviving industrial remains of the 17th to 19th centuries. It is hoped that the committee will be able to draw into a programme of planned recording and research the wide variety of interests in the subject.

The Committee's first project was a public conference, held on 12 December, 1959, at the London School of Hygiene and Tropical Medicine. The meeting included papers on recent research, on the problems awaiting study and the methods required.

Scottish Natural Resources.—A 'Committee on Natural Resources in Scotland' (see p. 26) has been set up by the Scottish Council (Development and Industry) to consider primary resources.

One of the Committee's objectives is to establish an organization to provide basic research information and to be of use to the research and development departments of industrial companies. The first task is the bringing together of eminent scientists to form a study group, with the following aims: an up-to-date assessment of natural resources, actual and potential, in Scotland; cross-fertilization of ideas between experts in the various fields of resource assessment, use and conservation; stimulation of interest in and a better understanding of Scottish natural resources; and a volume of transactions which will be available to industrial companies and individuals.

THE REGISTER

NEW FELLOWS

(P) BOYD, Gerhard Viktor, B.SC., PH.D. (LOND.)
(P) CLARKE, Eustace George Coverley, M.A. (OXON.), PH.D. (R'DG.)
(H) JOHNSON, Alan Woodworth, M.A., SC.D. (CANTAB.), B.SC., PH.D. (LOND.), A.R.C.S.

ASSOCIATES ELECTED TO THE FELLOWSHIP

(U) COOPER, Ronald Lifton, M.SC., PH.D. (LOND.), A.M.INST.GAS E.
(Q) DAVIES, Ben Owen, B.SC. (WALES)
(G) FISHER, James Edwin, B.SC. (LOND.)
(P) GOUGH, Donald, B.SC., PH.D. (LOND.), D.I.C.
(O) KANE, John, B.SC. (LOND.)
(G) KAYE, Anthony Harmsworth, B.SC. (LOND.)
(Q) MANDLEBERG, Charles John, M.A., B.SC. (OXON.)
(P) MULLER, Ervin George, B.SC. (MANC.)
(P) PYRAH, Alan Frederick, B.SC. (LOND.), F.INST.PET.
(O) RAND, John Arthur
REES, Gwilym Jenkyn, B.SC., PH.D. (LOND.)
(C) ROTHWELL, Eric
(OA) SWALLOW, John Eric Langley, B.SC. (R'DG.)
(E) TOMPKINS, William Arthur
(P) TOWNLEY, Eustace Raymond, B.SC. (LOND.)
(P) WALKER, John Howard, M.A., B.SC. (OXON.)
(O) WATERHOUSE, Geoffrey, B.SC. (MANC.), A.M.I.CHEM.E.

NEW ASSOCIATES

(C) ABBEY, Frank, M.A. (CANTAB.)
(P) BARNES, Peter James, B.SC. (LOND.)
(P) BUNYAN, Peter John, B.SC. (DUNELM.)
(P) COOK, Harry Aaron, B.SC. (LOND.), A.R.C.S.
(P) COOK, Thomas Edward
(U) DUCKER, John William, B.SC., PH.D. (LOND.)
HARRISON, John Graham, B.SC. (BIRM.)
(P) KENNEDY, John George, B.SC. (DUB.)
(P) LUCKCUCK, Henry Peter, A.R.C.S.
(P) MCASKILL, Noel Anthony, A.R.A.C.I.
(P) O'SULLIVAN, Denis Joseph, M.SC. (N.U.I.)
(FF) SANDFORD, Peter Edgar, B.A. (CANTAB.)
(P) SEAMAN, Geoffrey Vincent Frederick, B.SC., PH.D. (LOND.), A.R.C.S.
(A) SKELCHER, Barrie William, B.SC. (LOND.), M.SC. (BIRM.)
(P) TALWALKAR, Vinayak Sakharam, B.SC. (BOM.)
(G) WOOD, Donald, B.SC. (LOND.)
(D) YEOMAN, Walter Bruce, B.SC. (LOND.)

GRADUATE MEMBERS ELECTED TO THE ASSOCIATESHIP

(P) ADEYEMO, David Adebisi, B.SC.TECH. (MANC.), A.M.C.T.
(P) ALEY, Walter John, B.SC. (LOND.)
(U) ALLEN, Jeffrey William, B.SC. (SHEFF.)
(C) BROCKINGTON, John
(O) BUCK, Ernest Roy, DIP.CHEM. (LOUGHBOROUGH)
(P) DENNEY, Ronald Colin, B.SC. (LOND.)
(S) EDGE, Noel Arthur
(C) GILES, Alan John, B.SC. (LOND.), A.C.T. (BIRM.)
(C) HICKMAN, Leslie Stanley
(R) HOLT, John Stuart
(Y) LARKIN, John Alexander
(Q) LUND, Frederic Arthur
(Q) NICHOLSON, David, B.SC. (LOND.)
(Y) NORTON, Edward Stephen
(X) PAGE, Dennis
(P) PURKIS, Arthur Eric
(O) ROBINSON, Ian
(E) SAUNDERS, John Edward
(D) SIDEBOTTOM, Ronald
(O) WALKER, Alan, B.SC. (SHEFF.)
(M) YOUNG, Gordon

NEW GRADUATE MEMBERS

(J) ALLSOPP, John Thomas, B.SC. (EDIN.)
(D) AYERST, Winifred Janet, B.SC. (BRIS.)
(P) BARNETT, Peter Jonathan, B.A. (CANTAB.)
(K) BOYD, John, B.SC. (GLAS.)
(Q) BURCH, John Eaton, B.SC. (LOND.)
(K) DICK, William Angus, A.R.C.S.T. (GLAS.)
(P) FAIREY, Michael Benjamin, B.SC. (LOND.)
(O) GREENHALGH, Allen Ramsden, B.SC. (BIRM.)
(K) HALDANE, John, A.R.C.S.T. (GLAS.)
(P) HINGE, Derek Colin, B.SC. (LOND.), A.R.C.S.
(P) HUGHES, John Gwynne, DIP.CHEM. (LOUGHBOROUGH)
(A) KEIR, Hamish Alexander, A.H.-W.C.
(WW) MCFARLANE, Duncan, A.H.-W.C.
(P) MARSH, Christopher Herbert, B.SC. (LOND.)
(X) MORLEY, Cyril Wesley, DIP.CHEM. (LOUGHBOROUGH)
(SS) PEARSON, Eric Francis, B.SC.TECH. (MANC.)
(Q) REES, Ronald Glenn, B.SC. (WALES)
(P) SAUNDERS, Harry Frederick William, B.SC. (LOND.)
(V) WEATHERSTON, John, A.R.C.S.T. (GLAS.)

DEATHS

Fellows

(P) COTTRALL, Leslie George, B.SC. (LOND.). Died 4 December, 1959, aged 67. *A.* 1917, *F.* 1939.
(P) HAWKINS, Ernest Mostyn. Died 7 December, 1959, aged 84. *A.* 1897, *F.* 1900.
(J) MILLER, Nicholas, B.SC., PH.D. (LOND.). Died May, 1958, aged 41. *F.* 1955.
(P) OSBORN, Harry William Edward. Died 26 November, 1959, aged 58. *A.* 1927, *F.* 1944.
(OH) RAY, Rames Chandra, M.SC. (CALCUTTA), D.SC. (LOND.). Died 3 December, 1959, aged 69. *F.* 1926.
(H) TAINSH, Peter Wright, O.B.E., M.SC. (LIV.). Died 5 November, 1959, aged 78. *A.* 1902, *F.* 1927.

Associate

(R) PAINTON, William George, B.SC. (LOND.). Died 20 May, 1959, aged 59. *A.* 1923.

Obituary

Thomas Booth. *B.* 26.8.1885. *Ed.* University of Manchester, 1905–08. M.Sc. He was appointed a science master under the Cheshire Education Committee in 1908 and took a similar post at the County High School for Boys, Leytonstone, in 1911. He served in H.M. Forces, 1917–19, and on his release became second master and senior science master at the Stretford Secondary School for Girls and Boys on its formation in 1919. When the Stretford Grammar School for Boys was established in 1928, he continued to serve the new school in the same capacities. On the death of the headmaster, Booth was appointed to succeed him and he held the position until his retirement in 1947. He excelled at football and cricket, and was also gifted musically. The school choir and orchestra owed much to him. (*A.* 1919). *D.* 25.6.59.

Sydney Thomas Bowden. *B.* 18.1.1900. *Ed.* Neath County School; University College of South Wales, Cardiff, 1918–22. He remained at Cardiff for a further three years to carry out research work and went to America and Holland during 1925 and 1926 for a similar purpose. M.Sc.(Mich.), D.Sc. (Leiden and Wales). He was appointed assistant lecturer in chemistry at the University College of South Wales in 1926, and later became senior lecturer, a post which he held at the time of his death. Since the war he was actively concerned with the chemical aspects of civil defence and was the Home Office Regional Scientific Adviser for Wales. He was the Honorary Representative of the Institute at the College. Author of a large number of scientific papers, and of a textbook on *The Phase Rule*. 'Dr Bowden was a quiet, unassuming, almost shy man, never seeking the limelight, always most helpful both to his colleagues and his students.' (*A.* 1922, *F.* 1931.) *D.* 4.8.59.

Donald Chisholm. *B.* 13.2.1895. *Ed.* Albert Road Academy, Glasgow; University of Glasgow, 1913–14, 1919–21; Royal Technical College, Glasgow, 1921–22. B.Sc. His studies were interrupted until 1919 by service in H.M. Forces during the First World War, when he attained the rank of Captain in the Royal Flying Corps. He was appointed lecturer in chemistry at the University of Glasgow in 1922, and he remained there for the rest of his life. He gained his Ph.D. in 1925. His research work during this period was in the terpene field under Professor G. G. Henderson. During the Second World War, he served in an honorary capacity as a Flight Lieutenant in the University Air Squadron. His main hobby was stamp collecting and he also gave valuable services to the scout movement as a lay-worker. (*A.* 1922.) *D.* 13.8.59.

Edwin Rodney Chrystall. *B.* 9.10.1886. *Ed.* Bancroft's School, Woodford; University College, London, 1904–07. B.Sc. He was appointed an assistant chemist in the Research Department, Royal Arsenal, Woolwich, in 1907, and left the following year to take a post as research chemist to Curtiss & Harvey Ltd, Cliffe-at-Hoo. He then became successively research chemist, Nobel's Explosives Co. Ltd, 1919; research chemist, Cross and Bevan, 1921; chief works chemist, Rayon Manufacturing Co. Ltd, 1921; plant control chemist, A. G. Allen & Co. Ltd, 1932; research chemist, Imperial Chemical Industries Ltd, Plastics Division, 1934. He remained there until his retirement, when he was chief analyst. (*A.* 1907, *F.* 1911.) *D.* 5.8.59.

Douglas Evans. *B.* 19.6.16. *Ed.* Hawarden County School; University College of North Wales, Bangor, 1934–37. B.Sc. He was appointed senior science master at Bethesda County School in 1938, where he remained until 1940, when he joined the Chemical Inspection Department of the Ministry of Supply as an experimental officer. He left in 1945 on his appointment as a petroleum technologist at the Shell Petroleum Co. Ltd. After serving in various locations in the United Kingdom, he was finally transferred in 1955 to Stanlow. At the time of his death he was Refinery Department manager. (*A.* 1944.) *D.* 8.2.59.

Bernard Goulding Fagan. *B.* 24.7.1888. *Ed.* Royal College of Science, Ireland, 1907–10. B.A., B.Sc. He entered the city laboratory, Dublin, in 1911, as a private assistant to Sir Charles Cameron, the first city analyst, and two years later came into the service of the Dublin Corporation as chief chemical assistant. He was appointed assistant public analyst to the City of Dublin in 1918 and became sole public analyst in succession to Sir Charles Cameron in 1921. As he was permitted to accept public appointments, he later became analyst to nine counties, eight boroughs (including the cities of Limerick and Waterford) as well as six county boards of health. He resigned from all these bodies at the time of his retirement from the Dublin Corporation in 1956, but he continued to act as chairman of the Food Advisory Committee set up by the Minister for Health in 1955. He also joined the board of Vitamins Ltd. He was a founder member of the Dublin and District Section of the Institute, for many years a Section Committee Member and a past Chairman of the Section. His interests in music, the arts and sports were exceedingly varied. He was a fine golfer, and in his younger days played water polo for the Dublin Swimming Club and for Clontarf. Of more than usual musical capacity, he played the 'cello at times for the Abbey Theatre Orchestra. (*A.* 1914, *F.* 1917.) *D.* 29.9.59.

John Frederick Ferns. *B.* 22.6.1888. *Ed.* Manchester Municipal Secondary School; University of

Manchester, 1905–08. B.Sc. He became a chemist at the Bolton Corporation Sewage Works in 1910, but two years later returned to the University of Manchester to take up research, as a result of which he was awarded the degree of M.Sc. He was appointed research chemist at the Birmingham Corporation Gas Works in 1915 and resigned in 1920 to take a post as lecturer at the Leicester Technical School. He returned to Birmingham in 1921 to join the Etna Lighting & Heating Co. and in 1927 became chemist and bacteriologist to the Colne Valley Water Co. He became an analyst in the laboratory of Mr T. McLachlan in 1936, and the following year was appointed lecturer in biochemistry at the Royal Institute of Public Health and Hygiene, London, a post which he held until his retirement in 1957. 'He was a most congenial companion and one of those good all-round persons, possessing a substantial knowledge of bacteriology, parasitology, helminthology and protozoology. He was especially interested in moulds and fungi.' (*A.* 1932.) *D.* 25.9.59.

Alfred Fisher. *B.* 18.1.1891. *Ed.* University College, Nottingham, 1912–15. B.Sc.(Lond.). He was engaged during the First World War as a chemist-in-charge at H.M. Factory, Oldbury. On the cessation of hostilities, he took a post at Midland Coal Products Ltd, East Kirkby, later becoming manager and chief chemist. He left this country in 1924 to join the Dominion Tar & Chemical Co. Ltd, Montreal, and some years later became a chemical engineer with the Universal Oil Products Co., Chicago. He returned to this country in 1933 and became a consulting engineer with H. A. Brassert & Co. Ltd. After this firm had been bombed, he moved to Prestbury, Cheshire, to advise on and assist in restoring Manchester's gas supply, which had been disrupted through enemy action. Later he joined the British Coal Utilisation Research Association. On his retirement, he was for a time a consultant to Mitchell Engineering Ltd. Complete retirement enabled him to indulge his hobbies of painting and photography, with golf as his main recreation. (*A.* 1918.) *D.* 20.4.59.

Thomas Edgar Fore. *B.* 7.5.1895. *Ed.* Birkenhead Institute; Central Technical School, Liverpool, 1913–14, 1919–22. B.Sc.(Lond.). He commenced his career as an apprentice chemist at Lever Bros Ltd, Port Sunlight, in 1911. He joined H.M. Forces in 1914 and saw service in France before being recalled to this country in 1916 to act as a shift chemist at H.M. Factory, Gretna. He returned to Lever Bros Ltd as a chemist in 1919, and the following year joined the Works Experimental Department, where he remained until the present Research Department was formed at Port Sunlight. During the Second World War he was voluntarily seconded to the Royal Ordnance Factory, Wrexham. He rejoined Lever Bros Ltd after the cessation of hostilities and was a Section Manager at the time of his death. 'He was a quiet person with a good sense of humour and very popular with his business colleagues.' (*A.* 1929.) *D.* 25.7.59.

Richard Selwyn Haskew. *B.* 8.12.1891. *Ed.* King's School, Canterbury; City and Guilds Technical College, and Imperial College of Science and Technology, London, 1908–12. He became confidential assistant to the managing director of the Cwmbran Chemical Co. Ltd (later merged with Imperial Chemical Industries Ltd) in 1912. He served in H.M. Forces during the First World War, attaining the rank of Staff Captain, H.A. On his return to civil life, he founded the General Chemical & Pharmaceutical Co. Ltd in 1919 and at the time of his death was Chairman and Managing Director. He was a member of the Departmental Committee on the Carriage of Dangerous Goods and Explosives in Ships, 1946–51, and subsequently of the Ministry of Transport Standing Advisory Committee, and had served on committees of professional bodies. He was awarded the O.B.E. in 1957. (*F.* 1931.) *D.* 17.8.59.

Elsie Woodward Kassner. *B.* 13.4.1896. *Ed.* Montagu House School, Weymouth; School of Pharmacy, London, 1917–21; Birkbeck College, London, 1919–21. She became a demonstrator in chemistry at the School of Pharmacy in 1919 and lecturer in physical chemistry in 1920. On her marriage in 1925 she went to America, where she remained until 1938. She then returned to the School of Pharmacy for a time and later joined the consulting practice of Harrison & Self, where she remained until 1955. (*A.* 1921, *F.* 1924.) *D.* 5.9.59.

Archibald Ernest Lain. *B.* 7.3.1898. *Ed.* City of Norwich School; Norwich Technical Institute,1913–16; London College of Pharmacy, 1919–20. After serving for one further year as a demonstrator at the London College of Pharmacy, he joined Harris Lebus Ltd in 1921, where he remained for the rest of his life, becoming chief works chemist and director of scientific research. He served on a number of technical committees and was the author of papers in the technical press. (*A.* 1941, *F.* 1951.) *D.* 15.5.59.

Samuel Judd Lewis. *B.* 29.7.1869. *Ed.* Goldsmith's Institute, London, 1891–95; University College, London; 1903–05; University of Tübingen, 1906–07. D.Sc. (Tübingen). He joined Dakin Bros as a pharmacist in 1894 where he remained until 1902. On returning to this country from Tübingen in 1907, he set up in practice as an analytical and consulting chemist, shortly afterwards becoming interested in spectroscopy and its application to chemical analysis, especially in pharmacy. He found time to do a great deal of work on absorption spectroscopy, particularly of blood proteins, and obtained the D.Sc. (Lond.) in 1927. He

also became interested in spectrofluorescence. In the early 1930s he initiated a course of lectures on spectroscopy at the Sir John Cass Institute which is still continuing. He was the author of a small book on *Spectroscopy in Science and Industry* (1933) and of a large number of scientific papers, mostly related to spectroscopy and associated topics. 'Dr Lewis was courteous always, kindly and considerate to his staff, and combined a rather sentimental outlook with great strength of character. . . . He is recognized universally as the founder of modern spectrochemical analysis, and it is fairly certain that if his career had been more closely linked to the academic world he would have been an even greater name in science, for with his intellectual powers, determination and foresight there would have been nothing to stop him from rising to the top.' (*A.* 1906, *F.* 1909.) *D.* 24.4.59.

Ioan Stuart Malcolm. *B.* 31.10.05. *Ed.* Robert Gordon's College; University of Aberdeen, 1923–29. M.A., B.Sc. For some years he was science master at the Higher Grade School, Aberdeen, before being appointed principal teacher of mathematics and science at Culter Junior Secondary School, the post he held at the time of his death. For many years he was closely associated with the Boy Scout and Rover movement and was convener of the Aberdeenshire Education Committee's youth panel. (*A.* 1929.) *D.* 23.9.59.

Robert Thatcher Rolfe. *B.* 14.3.1883. *Ed.* County School, Richmond, Surrey; King's College, London, 1901–04. He received his practical training with Riley and Harbord, analytical and consulting chemists. He became an assayer to Terra Nova Properties Ltd and the Anglo-Newfoundland Development Co., Newfoundland, in 1910, and in the course of his duties visited smelting works in France, Germany, Norway and Sweden. He was appointed metallurgist to W. H. Allen, Sons & Co. Ltd in 1912, later becoming chief metallurgist. He was employed by this firm until his retirement in 1955, though he remained associated with the company in a consultative capacity. He was awarded the O.B.E. in 1952. Author or co-author of *The Romance of the Fungus World* (1925), *Foundrywork and Metallurgy* (1930), *A Manual of Foundry Practice* (1934), *Steels for the User* (1937), *Non-Ferrous Foundry Practice* (1940), *A Dictionary of Metallography* (1945), and of scientific papers. (*A.* 1908, *F.* 1911.) *D.* December, 1958.

James Francis Ronca. *B.* 27.7.1880. *Ed.* Battersea Polytechnic; Royal College of Science, London, 1898–1901. His first appointment was in the chief laboratory of the Associated Portland Cement Manufacturers Ltd, Gravesend. He joined the examining staff of H.M. Patent Office in 1903, transferring to the Board of Trade headquarters in 1914, where he helped to establish the Department of Industries and Manufactures. Appointed O.B.E. in 1923. He later became director of Gas Administration in 1933, and, on the formation of the Ministry of Fuel and Power in 1942, he became adviser to the Director-General of Gas Supply. Subsequently he succeeded J. S. Haldane as one of the gas referees. He retired in 1943. He was President of the Institute of Fuel, 1950–51, and was an Honorary Member of the Institution of Gas Engineers. (*A.* 1918.) *D.* 10.8.59.

Eric Percy Rydings. *B.* 9.6.1891. *Ed.* Berkhamstead Grammar School; University College, London, 1907–11. B.Sc. He joined A. O. Ferguson & Co. Ltd, as chemist and assistant works manager in 1913. He served in the Royal Navy during the First World War and was released in 1917 to accept the post of manager of the Ioco Proofing Co. Ltd, Glasgow. Later he took a post as works manager at the Monarch Rubber Co. Ltd, Manchester, and joined Zama Ltd as managing director in 1932, where he remained until his retirement in 1958. He was chairman of the Rubber Proofers Association, 1949–58. His chief pastime was golf. (*A.* 1918.) *D.* 21.8.59.

Benjamin Simons. *B.* 8.4.1899. *Ed.* City and Guilds Technical College, Finsbury, 1916–18; Birkbeck College, 1919–23. He joined W. J. Bush & Co. Ltd as a general analytical works chemist in 1918, and remained with this firm for the remainder of his life, becoming colour chemist in 1934 and later works chemist and departmental manager. (*A.* 1940, *F.* 1944.) *D.* 28.2.59.

Robert Guy Stuart. *B.* 5.11.11. *Ed.* West Ham Municipal College, 1928–31. B.Sc. He joined the staff of British Drug Houses Ltd as an assistant analyst in 1928. He served in H.M. Forces from 1939 to 1941, when he was discharged on medical grounds. He returned to British Drug Houses Ltd, where he remained for the rest of his life as development research chemist. (*A.* 1939, *F.* 1947.) *D.* 15.7.59.

Reginald Frank Wright. *B.* 29.3.03. *Ed.* Brighton Grammar School; Royal College of Science, London, 1922–24, 1926–27 (interrupted by illness). B.Sc. He was appointed assistant analyst in the laboratory of Standard Telephones & Cables Ltd in 1927, and became assistant analyst to Dr S. Allinson Woodhead, consulting chemist and Public Analyst, in 1929. On the death of Dr Woodhead in 1942, he took over the practice and was appointed Public Analyst and Official Agricultural Analyst for the Counties of East and West Sussex and the County Boroughs of Brighton, Eastbourne and Hastings, as well as Public Analyst for the Boroughs of Hove and Worthing, positions which he held until his death. (*A.* 1927, *F.* 1935.) *D.* 6.9.59.

LOCAL SECTIONS OF THE INSTITUTE

DIARY OF MEETINGS

Sections are glad to welcome members of other Sections to their meetings and social functions, except when numbers are restricted, as for works visits. Those wishing to attend meetings outside their own area are advised to write to the Hon. Secretary of the Section concerned, as the Institute cannot accept responsibility for any alterations or cancellations. All times are p.m. except where otherwise stated.

(A) **Aberdeen.** 19 Feb. 8. Chemical Society Centenary Lecture. Prof. N. A. Sorensen. University Union. Joint, C.S., S.C.I.

(C) **Birmingham.** 17 Feb. 6.30. Commercial Applications of Radiation-Sensitive Materials. Dr J. D. Kendall. College of Advanced Technology, Gosta Green

(SS) **Blackburn.** 18 Feb. 7.30. Chemical Bonding in Compounds of the Transition Elements. Prof. H. C. Longuet-Higgins. Technical College

(P) **Brighton.** 29 Jan. 6.30. Opportunities in Chemistry: Educational and Industrial. Drs J. H. Skellon and N. Booth. Technical College. Joint, College Chem. Soc.

(SS) **Burnley.** 11 Feb. 7.30. Growth of Fluorocarbon Chemistry. Prof. R. N. Haszeldine. Municipal College

(E) **Cardiff.** 25 Feb. 7. Ladies' Night: Fashion Show and Demonstration by British Nylon Spinners. Royal Hotel. Joint, S.C.I.

(P) **Dartford.** 11 Feb. 7. Cementing Action. Prof. J. D. Bernal. N.W. Kent College of Technology, Miskin Road

(F) **Dublin.** 3 Feb. 5.30. Some Aspects of the Chemistry of Quaternary Ammonium Compounds. Dr J. McKenna. University College. Joint, C.S.
—— 17 Feb. 7.45. Science in the Detection of Crime. A. J. Howard. University College.

(J) **Edinburgh.** 26 Jan. 7.30. Reaction Mechanisms. Prof. E. D. Hughes. Biochemistry Lecture Theatre, Teviot Place. Joint, University Chem. Soc.
—— 18 Feb. 7.30. Concept of Food Science. Prof. J. Hawthorn. North British Hotel

(WW) **Falkirk.** 27 Jan. 7.30. Chemistry and Criminal Investigation. Detective Chief Inspector J. K. McLellan. Lea Park Rooms
—— 24 Feb. 7.30. High Speed Arithmetic. Dr D. C. Gilles. Lea Park Rooms

(D) **Gloucester.** 18 Feb. 7.30. Chemotherapeutic Research. Dr F. L. Rose. Technical College

(L) **Huddersfield.** 16 Feb. 7.30. Visit to Elland Power Station

(P) **Kingston.** 4 Feb. 6.30. Water-Repellent Surfaces. Prof. N. K. Adam. Technical College, Fassett Road. Joint, College Chem. Soc.

(N) **Leeds.** 15 Feb. 6.30. Some Aspects of the Structural Chemistry of Platinum. Prof. E. G. Cox. Chemistry Lecture Theatre, The University

(H) **Leicester.** 18 Feb. 7.30. Preparation of Carbon-14 Compounds. Dr J. R. Catch. College of Technology. Joint, College Soc.

(O) **Liverpool.** 4 Feb. 7. Some Recent Developments in the Porphyrin Field. Prof. G. W. Kenner. Lecture Theatre, The University, Vine Street

(P) **London.** 9 Feb. 6. Reaction Mechanisms. Prof. E. D. Hughes. Sir John Cass College, Jewry Street, E.C.3. Joint, College Chem. Soc.

(P) —— 17 Feb. 6. Rocket Propellants. Dr W. G. S. Parker. King's College, Strand, W.C.2

(S) **Newcastle.** 17 Feb. 6. Why Polymerization Occurs. Prof. F. S. Dainton. King's College. Joint, C.S.

(G) **Norwich.** 18 Feb. 7.30. Some Chemical Aspects of Nuclear Reactor Operation. J. D. M. McConnell. City College

(P) **Norwood.** 23 Feb. 6. Film Show. Technical College, Knight's Hill, S.E.27

(H) **Nottingham.** 23 Feb. 8. Developments in the Study of Electrophilic Substitution. Prof. Sir Christopher Ingold. Chem. Dept., The University. Joint, C.S. and University Chem. Soc.

(W) **Plymouth.** 19 Feb. 5.30. Chemical Aspects of Soil Fertility. Dr G. W. Cooke. Technical College

(R) **Poole.** 26 Feb. 7.30. Living Material as a Factory. Dr C. W. Parr. Generating Station. Joint, Poole Technical Group

(SS) **Preston.** 29 Jan. 2.30. Liquefaction of Gases. Dr S. A. Miller. Avenham Institute

(U) **Rotherham.** 10 Feb. 7. Some Aspects of Peptide Chemistry. C. Fox. College of Technology

(FF) **St Andrews.** 26 Feb. 5.15. Chemistry of Poisoning. Dr A. S. Curry. The University. Joint, University Chem. Soc.

(R) **Salisbury.** 11 Feb. 7.45. Chemical Aids to Better Crops. G. L. Baldit. Cathedral Hotel. Joint, Salisbury Field Club

(U) **Sheffield.** 23 Feb. 7.30. Ladies' Evening: Lecture and Demonstration. Prof. J. B. Speakman and Miss J. Lindsay. Royal Victoria Hotel

(P) **Slough.** 27 Jan. 7. Non-Aqueous Solvent Systems. Dr C. C. Addison. College of Further Education, William Street. Joint, College Sci. Soc.

(V) **Swansea.** 19 Feb. 7. Informal Dinner. Langland Bay Hotel

(P) **Walthamstow.** 3 Feb. 7. Film Show. S.W. Essex College of Technology, Forest Road, E.17

(EE) **Whitehaven.** 5 Feb. 2.30. Schools Lecture: 50 Years of Plastics and Polymers. Dr T. T. Jones. College of Further Education, Flatt Walks
—— 5 Feb. 7.45. Members' Lecture. College of Further Education, Flatt Walks
—— 25 Feb. 7.45. Inorganic Stereochemistry. Prof. R. S. Nyholm. College of Further Education, Flatt Walks

(T) **Wrexham.** 12 Feb. 7.30. A.G.M. followed by Film Show. Denbighshire Technical College
—— 24 Feb. 7.30. Substituent Effects in Some Electrophilic Aromatic Substitutions. Dr C. Eaborn. Denbighshire Technical College

HON. SECRETARIES

Section	*Hon. Secretary*
(A) Aberdeen and North of Scotland	**P. N. Hobson,** B.SC., PH.D., F.R.I.C., Rowett Research Institute, Bucksburn, Aberdeen.
(B) Belfast and District	**R. J. Magee,** M.SC., PH.D., A.R.I.C., 255, Holywood Road, Belfast
(C) Birmingham and Midlands	**J. E. Gregory,** B.SC., PH.D., F.R.I.C., 5, Silvermead Road, Sutton Coldfield
(D) Bristol and District	**R. W. Bolland,** B.SC., PH.D., F.R.I.C., College of Technology, Ashley Down, Bristol 7
(E) Cardiff and District	**R. F. Stephens,** F.R.I.C., Skelmorlie, Stow Park Circle, Newport, Mon.
(EE) Cumberland and District	**A. Naylor,** B.SC., PH.D., A.R.I.C., 21, Santon Way, Seascale, Cumberland
(F) Dublin and District	**J. T. O'Herlihy,** B.SC., F.R.I.C., 21, Ballymun Avenue, Ballymun, Dublin
(FF) Dundee and District	**K. R. Hargreaves,** B.SC., PH.D., F.R.I.C., Chemistry Department, The Technical College, Bell Street, Dundee
(G) East Anglia	**H. F. Bamford,** M.A., F.R.I.C., John Mackintosh & Sons, Ltd (Caley Branch), Chapelfield Works, Norwich
(H) East Midlands	**E. R. Pike,** F.R.I.C., 225, Markfield Lane, Markfield, Leics.
(J) Edinburgh and East of Scotland	**K. A. Scott,** A.R.I.C., Department of Chemistry, Heriot-Watt College, Chambers Street, Edinburgh, 8
(K) Glasgow and West of Scotland	**W. Gibb,** B.SC., PH.D., A.R.T.C., A.M.INST.F., A.R.I.C., Department of Technical Chemistry, Royal College of Science and Technology, George Street, Glasgow, C.1
(L) Huddersfield	**R. R. Pritchard,** B.SC., PH.D., A.R.I.C., 16, Ripon Avenue, Fartown, Huddersfield
(M) Hull and District	**L. Malin,** B.SC., A.R.I.C., The Universal Oil Co. Ltd, Oak Road, Newland, Hull
(N) Leeds Area	**W. A. Wightman,** M.A., F.R.I.C., The University, Leeds, 2
(O) Liverpool and North-Western	**J. Ashley-Jones,** F.R.I.C., c/o J. Bibby & Sons, Ltd, Great Howard Street, Liverpool, 3
(P) London	**G. C. Ackroyd,** B.SC., A.R.I.C., Warren Spring Laboratory, Stevenage, Herts.
(Q) Manchester and District	**R. Shackleton,** F.R.I.C., Magnesium Elektron Ltd, P.O. Box No. 6, Clifton Junction, Manchester
(R) Mid-Southern Counties	**L. C. Thomas,** B.SC., F.R.I.C., 65, St Francis Road, Salisbury, Wilts.
(S) Newcastle upon Tyne and North-East Coast	**H. L. Hutton,** B.SC., F.R.I.C., 26, Long Close Road, Hamsterley Mill Estate, Rowlands Gill, Co. Durham
(SS) North Lancashire	**R. E. Wilson,** B.SC., A.R.I.C., 315, Blackpool Road, Preston, Lancs.

Section	*Hon. Secretary*
(T) North Wales	**S. McLintock,** B.SC., F.R.I.C., Chemistry and Metallurgy Dept, Flintshire Technical College, Connah's Quay, Nr Chester
(U) Sheffield, South Yorkshire and North Midlands	**J. D. Hobson,** B.SC., PH.D., A.MET., A.I.M., F.R.I.C., 38, Springfield Avenue, Millhouses, Sheffield, 7
(V) South Wales	**E. E. Ayling,** M.SC., F.R.I.C., University College, Singleton Park, Swansea
(W) South-Western Counties	**B. M. Dougall,** M.SC.AGRIC., F.G.S., A.R.I.C., Chemistry Dept, Seale-Hayne Agricultural College, Newton Abbot, Devon
(WW) Stirlingshire and District	**R. W. Rae,** A.H.-W.C., A.R.I.C., Nappyfaulds House, By Falkirk, Stirlingshire
(X) Tees-side	**G. H. Mansfield,** B.SC., PH.D., A.R.I.C., 86, Harlsey Road, Hartburn, Stockton-on-Tees, Co. Durham
(Y) Thames Valley	**E. S. Lane,** B.SC., PH.D., F.R.I.C., Building 429, Chemistry Division, A.E.R.E., Harwell
(OA) Malaya	**W. Rintoul,** B.SC., PH.D., F.R.I.C., Singapore Polytechnic, P.O. Box 2023, Singapore
(OB) Cape	**J. F. Largier,** M.SC., PH.D., A.R.I.C., Little Acorn, Bishopsgate Drive, Claremont, Cape Town
(OC) New Zealand	**H. J. Wood,** B.SC., A.R.I.C., Dominion Laboratory, Sydney Street West, Wellington
(OD) Deccan	**S. C. Pillai,** B.A., PH.D., A.I.I.SC., M.INST.S.P., A.R.I.C., Indian Institute of Science, Bangalore, 12, India
(OE) Madras	**K. R. Srinivasan,** M.A., F.R.I.C., King Institute, Guindy, Madras, 15, S. India
(OF) Western India	**J. R. Merchant,** M.SC., PH.D., A.R.I.C., Institute of Science, Mayo Road, Bombay, 1, India
(OG) Northern India	**S. K. Mukerjee,** M.SC., PH.D., A.R.I.C., Department of Chemistry, The University, Delhi, 8, India
(OH) Eastern India	**A. B. Sen Gupta,** M.SC., PH.D., F.T.I., F.R.I.C., Indian Jute Mills Association Research Institute, 17, Taratola Road, Calcutta, 27
(OJ) Ceylon	**C. Satkunananthan,** B.SC., S.M., F.R.I.C., Department of Government Analyst, Torrington Square, Colombo, 7, Ceylon
(OK) East Africa	**R. F. Naylor,** B.SC., PH.D., A.R.C.S., D.I.C., F.R.I.C., Department of Chemistry, Makerere College, P.O. Box 262, Kampala, Uganda